# HISTORY OF HINDU CHEMISTRY

BY

SIR PRAPHULLA CHANDRA RAY, Kt., D. Sc., Ph. D.

VOL. II

Second Edition: Revised and Enlarged

# RAMA VARMA RESEARCH INSTITUTE. TRICHUR, COCHIN STATE.





#### SELECT OPINIONS ON FOL. I.

I consider that the work is a most interesting and valuable contribution to chemical History ; and exhibits an amount of learning and research which does the author the greatest credit,-Sir Henry E. Roscoe.

A new and interesting chapter has been added to the history of sciences and of human progress.-M. Berthelot.

Dr. Ray has spared no pains to make his work a masterpiece of its kind. - The Pimeer.

Dr. Ray has ably carried out his task. SDASSOL -Nature.

That unusually interesting work. - Pharma. centical Post. (Vienna)

We doubt if one more coninently qualified than Professor Ray could be found for the difficult task of sifting such evidences, and eliciting from them an intelligible and orderly account of the development of Indian Chemistry. The Times of India.

This Pioneer work is a monumental labour of love. The Englishman.



# HISTORY OF HINDU CHEMISTRY



### HISTORY OF HINDU CHEMISTRY

#### FROM

THE EARLIEST TIMES TO THE MIDDLE OF THE SIXTEENTH CENTURY A. D.

#### WITH

SANSKRIT TEXTS, VARIANTS, TRANSLATION
AND ILLUSTRATIONS

BY

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#### VOL. II

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# RAMA VARMA RESEARCH INISTITUTE. TRICHUR, COCHIN STATE.

## Co the Memory of

M. P. E. BERTHELOT

I dedicate this volume of the History of Hindu Chemistry.



#### PREFACE

The second and concluding volume of the History of Hindu Chemistry is now presented to the public.

When the first volume was under preparation, it was feared that many valuable works on Hindu Chemistry referred to in Rasárzava, Rasaratnasamuchchaya, etc., had been lost for ever. Pandit Navakānta Kavibhúshaza was deputed to Benares to make a searching enquiry and his labours have been rewarded by the discovery of several rare MSS., including one of Rasahridaya. This last-named work is of surpassing interest considering its comprehensiveness and antiquity. Two more transcripts of it have also been procured from the Libraries of the India Office, Lordon, and of the Darbar, Nepal. A copy of Rasendrachúdámani obtained from the Library of the Deccan College, Poons, has also been of signal help. A critical study of the new materials throws a flood of light on the dark recesses of the history of Indian Chemistry. As a halo of literary and scientific activity including the pursuit of alchemy circles round the prominent figure of Nágárjuna, considerable space has been devoted to a discussion of his age in the Historical Introduction.

It was with diffidence and hesitation that I placed the remotest limit of alchemical *Tantras* in the 12th century A. D. It now transpires that this date is to be pushed back by several centuries.

History of Hindu Chemistry would be rightly regarded as incomplete which did not deal with the constitution of matter and the various hypotheses in regard to it. The European historian of chemistry has always turned his eyes to Greece as the perennial fountain of knowledge on this as on other subjects. And it is but natural that he should do so. \* The Hindu atomistic school has not hitherto, I am afraid, found an interpreter who could do full justice to it. Colebrooke's presentation of it with which I had to content myself in the first volume is masterly so far as it goes, but is fragmentary. Not feeling myself equal to the task I applied for help to Mr. Brajendra Nath Seal Principal, Victoria College. Cooch Behar, Principal Seal has kindly responded to my appeal with alacrity. It is to be hoped that a long-felt desideratum has at last been supplied.

The frequent references which have been made to the first volume must be taken to mean the second edition of it. Those who happen to possess copies of the first edition will not, however, be put to any serious inconvenience. I avail myself of this opportunity to express my cordial thanks to Pandit Harischandra Kaviratna late Professor of Sanskrit, Presidency College, and my collaborator in the editing of the text of Rasarnava in the Bibliotheca Indica series.

In the preface to the first volume I presumed to narrate the circumstances under which I undertook the composition of my History. The great chemist and savant, whose inspiration has been my guiding principle throughout the arduous task and whose lengthy and appreciative review of the first instalment has been a stimulus in the continuation of it is no more. Marcellin Berthelot breathed his last on March 18, 1907, leaving the world of science poor indeed. It was with the view of coming into personal contact with the illustrious scientist that the author made a pilgrimage to Paris in March, 1905. The long interview which he had with M. Berthelot and the reception which was accorded to him at a meeting of the Academy of Sciences by its late Perpetual Secretary, as also by its President M. Troost, made a deep and lasting impression on his mind.

Alas, for the vanity of human wishes! These pages will no longer be greeted by the eager and indulgent eyes of M. Berthelot. All that now remains for me is to dedicate this volume to his sacred memory.

It is with mingled feelings that I mark the hour of my final deliverance from a self-imposed task which has occupied all my spare time during the last 15 years and more—feelings not unlike those which overpowered the Historian of the Roman Empire. The reader will, I hope, forgive me if I venture to give expression to them in the words of Edmund Gibbon himself. "I will not dissemble the first emotions of joy on the recovery of my freedom.

\* But my pride was soon humbled, and a sober melancholy was spread over my mind, by the idea that I had taken an everlasting leave of an old and agreeable companion."

The Hindu nation with its glorious past and vast latent potentialities may yet look forward to a still more glorious future, and, if the perusal of these pages will have the effect of stimulating my countrymen to strive for regaining their old position in the intellectual hierarchy of nations, I shall not have laboured in vain.

PRESIDENCY COLLEGE

P. C. RAY.

June 1, 1909.

#### PRELIMINARY REMARKS ON THE MECHANICAL, PHYSICAL AND CHEMICAL THEORIES OF THE ANCIENT HINDUS.

My paper on the Mechanical, Physical and Chemical Theories of the Ancient Hindus is intended to be a synoptic view of the entire field of Hindu Physico-chemical Science, so far as this reached the stage of positive Science as distinguished from the prior mythological and empirical stages. As the work in which my paper appears relates to Hindu Chemistry, I have elaborated the chemical portions, including the Hindu account of the constitution of the fats and oils and the organic tissues in addition to Hindu inorganic chemistry. I have also briefly noticed the chief chemical industries of the Hindus which secured them an easy pre-eminence in manufactures for a thousand years, and, in the Addenda, given some interesting recipes relating to several matters of chemical technology. Of mechanico-physical theories, I have expounded the Hindu conception of Energy, potential as well as kinetic, and of molecular motion, so far as they are applied to the elucidation of problems of a physico-chemical nature, viz., the constitution of

matter, the genesis of atoms and their infra-atomic constituents, and the chain of mechanical causation in the system of Nature. I have also touched on the Hindu theories of light, heat and sound, as implying current or wave motion, leaving the elaborate exposition to my paper on Hindu Mechanics and Physics. In the Appendix, I have added a brief account of the Scientific Method of the Hindus, which shows that all this was not a mass of unverified and unverifiable speculation (the very antipodes of science), -the charge usually brought against Hindu thought and culture,-but professed to be the outcome of a Scientific Methodology which, in its formulation of the canons of the two fundamental Inductive Methods, is more comprehensive as well as more original and suggestive than Mill, and which, as regards its Applied Logic of the Sciences, (e.g. the Logic of Therapeutics, of Grammar etc.), is a standing testimony to the systematic completeness and rigour of the Hindu scientific mind. The difficulties of my task have been formidable, but I have not written one line which is not supported by the clearest and most authoritative texts. The ground trodden is, for the most part, absolutely new. I have gone back to the origines, and studied the authorities at first hand, being resolved to eschew all second-hand sources of imformation. Fortunacely the Sanskrit philosophico scientific terminology,

however difficult from its technical character, is exceedingly precise, consistent and expressive. The materials also are full and the sources information corroborate one another. Another difficulty I have sought to guard myself against is the unscientific, unhistorical but very common and almost inevitable habit of reading modern ideas into old guesses or speculations of a happygo-lucky or nebulous character. I do not think that the mere passion for Truth is a sufficient safeguard against this fatal facility of unconscious distortion or misrepresentation. A true historical perspective can only be acquired by historico-comparative studies, with the application of the correct historico-comparative method ( ride the Introduction to my Comparative Studies in Vaishnavism and Christianity ). I have also practised, or tried to practise, a habitual understatement, without consciously falling into that 'suppressio veri' which is so often a 'suggestio falsi.' How far I have succeeded in exhiditing the truth about Hindu science or the Hindu scientific mind is a question which I leave to competent judges to answer.

Before concluding, I must advert to my use of the terms "isomeric" and "polymeric" in senses different from the current ones, though suggested by the principle of analogous extension. Instead of coining new terms, I adopted (perhaps with a questionable freedom) these existing ones to ex-

press the Hindu idea of distinctions of chemical substances due merely to difference in spatial position or arrangement among the particles, without any implications whatever as to percentage composition or molecular weight. A study of the original sources has made it clear to me that a "Bhuta" in Hindu Chemistry represents a class of elements composed of similar atoms, and the different elementary substances comprised under one and the same "Bhuta" are 'isomers', in this limited sense, in reference to the atoms, being specifically constituted by differences of spatial position and arrangement among the latter. This is true of the Sankhya-Patanjala and the Nyaya-Vaiseshika alike. But in the Sankhya-Patanjala, the atoms themselves are composed of Tanmatras; and in one view, the atoms that enter into the "isomeric" modes of the same "Bhuta" are themselves "stereo-isomers" in reference to the Tanmatras. A tri-Tanmatric atom, for example may have different isomeric forms which would account for the divers modes of the "Bhúta" originating with this class of atoms. Hence under the Sankhya Pátanjala, I speak of "isomeric" atoms, while under the Nyáya-Vaiseshika I confine myself to the phrase "isomeric modes of the same Bhúta". It appears to me also that in the Sánkhya-Pátanjala view, while an atom of a particular kind (say a tri-Tanmátric or a tetra-Tanmátric one ) may have "isomeric" forms of its own, the

atoms of the different "Bhûta" classes (from the mono-Tanmatric to the penta-Tanmatric) are what may in a broad sense be termed polymers of the A'kasa Tanmatra and Bhûtadi (matter-radiment). Under the Sankhya-Patanjala, therefore, I have spoken of 'polymeric' atoms and 'polymeric' combinations of these, though I must confess that I have done so with great diffidence and hesitation.

VICTORIA COLLEGE COOCH BEHAR. 23rd May. 1909.

B. N. SEAL



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#### Introduction

#### CHAPTER I

#### On the age of Magariuna and the Buddhist Alchemical Tantras.

In the first Volume it has been incidentally mentioned that side by side with the Sivaite

and propagation of Mahayanism.

Rise, development Tantras we have their Buddhist counterparts in which the salient features of the for-

mer appear. The question now arises: when did the votaries of the religion of Sakyamuni find themselves called upon to engraft upon their simple and pure creed the ensemble of the gross and grotesque superstitions, the hideous incantations, as also the speculative, the metaphysical and esoteric phases of spiritual aspirations of which the Tantras are the repositories? The answer cannot be given off-hand

<sup>.</sup> Vol. i, Intro. lax.

in a few words, for it will lead us to a discussion of the origin and development of Maháyánism. Under ordinary circumstances we should have considered it beside our purpose to devote much space to this subject in a work dealing with the history of chemistry. But it so happens that the most prominent figure in Indian alchemy, who is acknowledged on all hands to be the discoverer of the processes of distillation, sublimation etc., is no other than the reputed founder of the Madhyamika system of philosophy, the renowned Nágárjuna. A brief and rapid survey of the causes which led to the origin of Maháyánism and its intimate connection with the tenets of the Sivaite cult will be of help to us.

It is one of the saddest episodes in the history of the great religions of the world that the purity of life, right conduct, right living—in short, the moral code upon which their founders have always laid particular stress, soon begin to occupy a subordinate position and a dogmatic theology springs up in time, which gives occupation to the subtlest intellect.

As for the masses of the people it is doubtful if ever they have remained contented with the mere ethical aspect of a religion. At any rate we find that immediately after the tidings of the death of Buddha had spread about there was a squabble among his followers for the possession of the master's corporeal relics and in course of time stúpas were raised over them, which no less than the three jewels (Ratnatraya)—the Buddha, the Dharma and the Samgha, and the Bodhi-tree became objects of worship of the devotee. The Chaityas, Viháras and other sanctuaries of divers sorts, with which Buddhistic India was dotted over in the first and second centuries after the decease of the great teacher, afforded asylums for a vast multitude of monks, who, freed from all worldly cares, found ample leisure to formulate and draw up a code of spritual and disciplinary exercises.

Although their high ideal was "to lead sweet lives of purest chastity" and induce their lay brethren to follow in their footsteps, rituals and ceremonials of an imposing and elaborate character soon obscured the ray of light which shone forth from the founder. Thus we find that within 150 years after the passing away of Buddha tedious and circumstantial regulations as to the quality of robes to be worn by the Bhikshus, the mode of bathing and fasting, the taking of the midday meal, the drinking of unchurned milk, probation and penance, dwellings and furniture and so forth were amongst the weighty subjects for discussion in the Second General Council.\* Weneed not pursue the subject further. The reader who is interested in the study of comparative religions will find striking parallels in the early history of the Christian Church.†

 <sup>&</sup>quot;On the daily Life of the Bhikshus". Vinaya Texts
 (S. B. E. Series). The Chullavagga, Pt. iii, p. 66.

<sup>†</sup> The Sermon on the Mount was more or less forgotten. Idolatry disappeared, it is true, but only to re-appear in the shape of Mariolatry and the worship of Saints and relics. In the heat of the schismatic strifes, Christian Charity had to make shift for itself as best as it could. Theologians were busy with the interpretation of the writings of the fathers. In a word, the dogmatic to a large extent superseded the moral element of religion.

We are not concerned here with tracing the rise, progress or decline of Buddhism; if we have at all referred to its excrescences, it is only to prepare the mind of the reader for the proper understanding of the Maháyánist development.

The India of Asoka and of the fourth and third centuries B. C. was in the main Buddhist, but it should not for a moment be supposed that the old faith was extinct. The triumph and ascendancy of the teachings of Sákyamuni and his followers were due in a large measure to the fact that they drew upon, and incorporated into, their creed much that was essentially of Hindu origin.\* As Dr. Bhándárkar observes:—

Prof. Rhys Davids expresses the same views in several places:—"There is ample evidence even in the books of the orthodox body of Brahman teachers to show that when Buddhism-arose there was not only much discussion of the ultimate problems of life, and a keen interest in the result but also that there was a quite unusually open field for all sorts of speculations".—"Buddhism." American Lectures on the History of Religions (1896), p. 26. Again: "But Buddhism is essentially an Indian system. The Buddha himself was,

"But it was not the metaphysical doctrines of Buddhism that influenced the masses of the people. What proved attractive was its ethical side. The Buddhist preachers discoursed on Dharma or right-eousness to the people. Such discourses on Dharma without the introduction of any theistic idea have their representatives in the Brahmanic literature. In many of the episodes of the Mahabharata especially in the Santi and Anusasanika books we have

throughout his career, a characteristic Indian."..... he was the greatest and wisest and best of Hindus,"-ibid, p. 117. The same high authority puts it more tersely when he says: "This is partly, no doubt, because we call them Buddhists, and imagine them, therefore, to belong to a separate class, quite distinct from other Indians of that stock. The Buddhists were, as a matter of fact, characteristically distinctly Indian."-"Buddhist India," p. 165. Cf. "Buddhism, in fact, may be regarded as a reformed phase of Hindu religion and ethical activity. The Buddhistic doctrine of the vanity of the world had been thoroughly disseminated by Yájmavalkya (in the Satapatha Brahmana) and with it the practice of subsistence upon alms as Pravrájaka or Bhikshu; and a fruitful soil had thereby been prepared for Buddhism". Weber's "Hist, Sans. Lit," trans, 3rd Ed. (1892) p. 285. Again "This teaching contains, in itself, absolutely nothing new; on the contrary, it is essentially identical with the corresponding Brahminical doctrine; only the fashion in which Buddha proclaimed and disseminated it was something altogether novel and unwonted."-ibid, p. 289.

simply ethical discourses without any reference to 'God, of the nature of those we find in the Buddhistic works; and sometimes the verses in the Mabábhárata are the same as those occurring in the latter. There appears to be at one time a period in which the thoughts of the Hindus were directed to the delineation of the right conduct in itself without any theistic learning. And Buddhism on its ethical scale represents that phase. Right conduct is the last of the four noble truths of Buddhism."

· 6800 100000

"It was this phase of Buddhism that with the strenuous efforts of the missionaries and of the Emperor Asoka enables it to achieve success amongst the masses of the people; and what was wanting on the theistic side was supplied by the perfection and marvellous powers attributed to the founder of the religion. Without this faith in the perfection or, what we should call the divine nature of Buddha, a mere ethical religion would probably not have succeeded. Buddhism was not a social revolution as has been thought by some writers. It was a religion established and propagated by persons who had renounced the world and professed not to care for it. From times of old there existed in the Indian community such persons who were

called Sramasas and belonged originally to all castes. These gave themselves to contemplation and sometimes propounded doctrines of salvation not in harmony with the prevalent creed. Buddhism was not even a revolt against caste, for though men from all castes were admitted to the monastic order, and though in the discourses of Buddha himself and others the distinction of caste is pronounced to be entirely worthless, still the object of those who elaborated the system was not to level caste distinctions. They even left the domestic ceremonies of their followers to be performed according to the Vedic ritual. This is one of the arguments brought against Buddhism by Udayanáchárya. "There does not exist", he says, "a sect, the followers of which does not perform the Vedic rites beginning with Garbhádhána and ending with the funeral, even though they regard them as having relative or tentative truth."\* Buddhism, however, was a revolt against the sacrifical system and denied the authority of the Vedas as calculated to point out the path to salvation. And

<sup>\*</sup>नास्त्रेव तहर्मनं यत साहतभितदित्युक्कापि मश्रीभानादान्त्रे ष्टिपर्धन । वैदिकी किया जनी नाहतिष्ठति । Atmatattvaviveka, Calc. Ed. of Samvat 1906, p. 19. साहत relating to संहति a Buddhist technical term.

this is the root of the hostility between itself and Brahmanism."•

The zealous missionaries of Buddhism captured the heart of the masses by appealing to their mora linstincts. Persuasion and not persecution was the instrument they chose to wield. King Asoka proclaimed universal toleration; he inculcated respect for Brahmins as well as Bramanas or ascetics of all sects. It is a relief to find that the mighty monarch had never recourse to brute force for the propagation of his creed. We are spared all the scenes of blood, rapine and violence, which disfigure the pages of religious history in the West.

It has already been pointed out that Buddhism itself may be looked upon as an offspring of Hinduism; nay, it is a logical outcome of the principles enunciated in the

<sup>&</sup>quot;"A peep into the Early History of India from the foundation of the Maurya Dynasty to the fall of the Imperial Gupta Dynasty" (B.C. 322—Circa 500 A. D.) pp. 362-363.

Journal of the Bombay branch of the Royal Asiatic Society (1900), Vol. xx. No. LVI.

Samkhya system of philosophy. If India soreadily responded to the teachings of the new faith, it is not because she renounced Hinduism but because she found that all that was highest and noblest in the latter was absorbed in the former. The great Teacher who now arose gave only a new shape and direction and a vigorous impetus to the germ of ideas already in existence and turned them to capital account. A good deal of confusion may be avoided by bearing in mind this aspect of the question. When speaking of Buddhist India one is apt to rush to the conclusion that every vestige of Hinduism had disappeared off the face of the vast continent. As a matter of fact even during the zenith of Buddhistic glory Brahminism was rearing its head and was professed by not a few among the cultured and intellectual classes and was ready to assert itself whenever a favourable occasion arose.

In the second century B. C., we find the Kábul valley, the Punjab and Málava acknowledging the sway of the Princes of the Turkish race. Wema Kadiphses, the second of the Kushana Dynasty is spoken of as a devotee of Mahesvara; his coins bear the emblem of Nandin on the reverse, which is accompanied by a human figure which holds a trident in its right arm representing Siva, † The last three Kushanas-Kanishka, Huvishka and Vásudevahave been noticed in the Rajataramgini, and the emblems on the reverse of their coins are figures of deities borrowed from the Greek, Persian and Brahminical pantheon and of Buddha. Thus the Gods of all these four religions shared the adoration of these Turkish Kings. But the figure of Buddha in the

Lassen "Indische Alterthumskunde," Vol. ii, pp. 811-13
 Ed. 1874.

<sup>+</sup> Ibid, pp. 808-811.

<sup>‡</sup> See next page. Regarding the reliability of the account in the Rájataramgini, Dr. Stein observes:—"Kalhana's account of the reign of these kings, who are supposed to have ruled simultaneously, is brief enough, but undoubtedly preserves data of genuine historical tradition. It clearly describes them as princes of Turuska, i. e., Turkish nationality, as powerful sovereigns and as faithful patrons of the Buddhist Church. On these points the statements of

sitting or meditative and the standing posture is to be found on the coins of Kanishka alone.\*

In the Buddhist ecclesiastical history Kanishka occupies a prominent place. It was in his reign and under his patronage that the Third Council was held to settle the canon once again. The church was convulsed by internal dissensions and schisms, resulting in its being split up into as many as 18 sects. "The most significant trait of the Third Council is that it closed a period of old quarrels between the sects; it did not prevent the rise of new aspirations. Maháyánism, which in an incipient stage was already existing crelong, boldly raised its head."†

the Chronicle are fully supported by the evidence of our most authentic records. The continued existence of the three places, Kanishkapura, Hushkapura, and Jushkapura, which are described as foundations of these kings and which still survive to the present day is likely to have assisted in preserving a recollection of their founders."

Percy Gardner: "Coins of Greek and Scythic kings"
 pp. 129 ff.

Cunningham : "Num. Chr.' 1892, pp. 63 ff.

<sup>†</sup> Kern: Manual of Ind. Bud. (Grundiss d. Indo.-Arischen Phil.) p. 122.

Hinduism was now very much alive. Afterthe Third Council the distinction between the Hinayánists and the Maháyánists became more and more accentuated. The apostles of the latter development became convinced that in order to draw into their folds the bulk of the people some sort of compromise was necessary, that orthodox Buddhism in all its rigidity must be given up. In other words, the neo-Buddhism which now sprang into existence began to absorb and assimilate the popular form of Brahminism and thus swell the ranks of its followers. A purely ethical creed has never secured a following except perhaps among a chosen few. To quote the eloquent words of the historian of "Rationalism in Europe" :-

"There arise from time to time men who bear to the moral condition of their age much the same relations as men of genius bear to its intellectual condition. They anticipate the moral standard of a later age, cast abroad conceptions of disinterested virtue, of philanthropy, or of self-denial that seem to bear no relation to the spirit of their time, inculcate duties and suggest metives of action that

appear to most men altogether chimerical. Yet the magnetism of their perfection tells powerfully upon their contemporaries. An enthusiasm is kindled, a group of adherents is formed, and many are emancipated from the moral condition of their age. Yet the full effects of such a movement are but transient. The first enthusiasm dies away, surrounding circumstances resume their ascendency, the pure faith is materialised, encrusted with conceptions that are alien to its nature, dislocated, and distorted till its first features have almost disappeared. The moral teaching being unsuited to the time becomes inoperative until its appropriate civilisation has dawned, or at most it faintly and imperfectly filters through an accumulation of dogmas, and thus accelerates in some measure the arrival of the condition it requires." Vol. i, p. 305, Ed 1900.

The same historian in explaining the rapid spread of Christianity in Europe observes in another place:—"It triumphed not so much by superseding rival faiths as by absorbing and transforming them. Old systems, old rites, old images were grafted into the new belief, retaining much of their ancient character, but assuming new names and a new complexion."

Among the bold spirits who took a leading part in this renovation the name of Nágárjuna The Mádhyamika sysstands conspicuous. tem, with its axiom—sarvam Sunyam—a form of Pyrrhonism pushed to its extreme limits, Nagarjuna : a lead- which is an essential part of ing representative of Maháyánism, is generally as-Mahayanism. cribed to him. Northern Buddhistic literature is replete with the marvels and miracles performed by him, and tradition has invested him with superhuman powers, Hiouen 'Thsang calls him along with Deva, Asvaghosha and Kumáralabdha, "as the four suns which illumine the world." As early as A.D. 401.409 we find a life of Nágárjuna Bodhisattva translated into Chinese,† Táranatha has committed to writing all the floating mass of legends connected with this venerable name, but as the Tibetan monk wrote so late as the beginning of the 17th century A.D., and as nothing was too astounding for his pious credulity, we have here only

Julien's texts, Vol. ii, p. 214.

<sup>+</sup> Bun. Nanjio's Catalogue, Ap. i, No. 3.

accretions of vast proportions. It is now almost a hopeless task to separate the grain from the chaff. Nevertheless we can glean certain historical data from all that have been handed down. Before proceeding further we think it proper to treat the reader to a specimen of the materials with which one has to deal. We cull the following bits from the "Life and Legends of Nagarjuna" 'gathered chiefly from Tibetan records including Taranatha's "History of Buddhism."

live seven years, beyond which its life could not be prolonged by any means whatever. When the seventh year was about to expire the parents were overwhelmed with grief. To avoid the painful sight of their son's predicted death, they caused him to be removed to a certain solitary place in company with a few retainers.

"As the boy (Nagarjuna) was passing his mournful days, one day the Mahabodhisattva Avalokiteswara Khasarpana visited him in disguise and advised him to go to the great monastery of Nalendra in Magadha as the surest means of escaping from the hands of death. He accordingly repaired to that famous Vihara and arriving at the gate recited some gathas. During that time the great sage Srī Saraha Bhadra was the high priest of Nalendra, ..... who ordained Nagarjuna a · During the Bhikshu of the Vihāra. latter part of his office the country was visited by a famine in consequence of which the monks fell into great distress. The Manager became very thoughtful about the terrible effects of the natural calamity. Distress and scarcity compelled the congregation more keenly to feel the necessity of money. The monks now determined to devise some means of acquiring treasures for the support

of the famished congregation, and Nagarjuna accordingly started on an expedition to visit an island in the great ocean where lived a great saint well versed in the art of alchemy. As the sea could not be crossed by any earthly means, he, by dint of his divine learning, got two leaves of an enchanted tree, by means of which he crossed the and miraculously visited the island and presented himself before the sage who was greatly surprised to see a human being arrived at his abode deemed inaccessible to mortal beings. The sage earnestly inquired how he succeeded in achieving this wonder. Nagarjuna replied respectfully stating to him the reasons of his visit and circumstances that brought him thither. He also showed him one of the enchanted leaves, concealing the other in his mendicant's platter. He begged him to teach him the art of turning metals into gold. The sage consented to the proposal, but not liking to let the wonderful art be known in Jambudvīpa, he determined to detain him for ever in the island by depriving him of the enchanted leaf. To effect this, he said that he could not teach the art of alchemy unless Nagarjuna consented to part with the leaf. Nagarjuna consented, and was taught the art. When it was fully mastered, he flew towards the Indian Continent by the help

of the remaining leaf. Returning to Nalendra, by means of his easily acquired wealth he supported the whole body of monks. By his religious practices he obtained Siddhi (perfection). He refuted the theories of Samkarāchārya\* and imparted religious instruction to the monks of Nalendra.

"Nāgārjuna returned to his country after a visit to Uttarakuru and erected many chaityas and temples, composed many works on science, medicine, astronomy and alchemy. After the death of Saraha Bhadra, the office of high priest fell upon Nāgārjuna, which he managed with great ability and indefatigable zeal. He matured the Mādhyamika philosophy which was only conceived by his illustrious teacher Saraha."

"Nāgārjuna is said to have been a great friend of king De-Chye (Samkara) of S. India, whom he converted to Buddhism."

An instance of glaring anachronism. Samkara flourished in the 8th.—9th century A. D. See below, foot-note to p, xxii.

<sup>+</sup> S. C. Dás : Journ, As. Soc. li, Pt. i, pp. 115-120.

One thing seems to be clear from the above, namely, that Nágárjuna was born and brought up in the Brahminical faith but was afterwards converted to Buddhism and was celebrated as an alchemist.

Táranátha, it is true, completed his History in 1608 A. D., \* but he derived his materials from Tibetan sources and the analysis of Dulva by Csoma goes te confirm this account. We have already made use of the record left us by Hiouen 'Thsang. † It is thus clear that all the testimonies concur in ascerting Nágárjuna not only as the originator of the Mádhyamika philosophy but also as an

Nagarjuna as an adept in magic, conjuration and alchemy, and that even so early as the 7th century

A. D. The exact time during which he flourished is a matter of controversy. He is generally regarded as a contemporary of

<sup>·</sup> Schiefner : Gesch. d. Bud. Pref. vi.

<sup>+</sup> Vide Vol. i, Intro. xciii.

Kanishka. One cannot go far wrong in assigning circa 150 Λ. D. as the date of his succeeding to the Patriarchate.\*

According to Lassen Nágárjuna lived about A. D. 23 during the reign of Kanishka. The Rajataramgini says: "Then there were in this land three kings called Hushka, Jushka and Kanishka, who built three towns named after them ( Hushkapura, Jushkapura and Kanishkapura )..... During the powerful reign of these [kings] the land of Kasmir was to a great extent, in the possession of the Buddhas. At that time 150 years had passed in this terrestrial world since the blessed Sakya Simha (Buddha) had obtained complete beatitude (Nirvana) ....... And a Bodhisattva lived ( then ) in this country as the lord of the land, namely, the glorious Nagarjuna ...... Stein's trans. Vol. I. pp. 30-31. As the tradition of the Northern Buddhists as recorded by Hionen 'Thsang (Si-yu-ki, 1. pp. 99, 151, the Tibetan Dulva (Csoma, As. Res. XX, pp. 92, 297) as also Schiefner (Tar, Gesch. d. Bud. p. 301) concur in placing the commencement of Kanishka's rule 400 years after Buddha's Nirvása, the date assigned here to Nagárjuna is rather curious. Lassen sums up his conclusion on this knotty point these words :- "Wegen der grossen Ansahl Munzen mus dem Kanishka eine ziemlich lange Regierung Zugeschrieben werden ; ich glaube daher annehmen zu durfen, das er etwa bis 40 nach Chr. G. regiert habe." Fleet maintains B. C. 57. V. Smith c. 120 A. D. While Messre. Bhánderkar c. 278 A. D. (Journ, Bombay Br. Roy. As. Soc. Vol. XX, No. lvi, pp. 269-366 ) as the date of Kanishka.

An important document has been preserved or us in its Tibetan and Chinese versions, which seems to have an historical basis. It is in the shape of a "Friendly Epistle of

Nagarjuna as a contemporary and friend of king Sadvahasa. Nágárjuna to king Udyana."\*
The original in Sanskrit, entitled Suhrillekha, has not yet been recovered and probably

been lost. Udyana in the Tibetan subscription is Bdye-Spyod = Sadváhana.† This Sadváhana is a prominent figure in the history of S. India. In ancient Sanskrit literature he is frequently spoken of as a patron of learning and there are several literary reminiscences associated with this name.‡

<sup>.</sup> Vide Wenzel : Journ, Pali Text Soc. (1886), p. 1.

<sup>+</sup> S. C. Dás (l. c.) says: "Nágárjuna is said to have been a great friend of king De-Chye (i. c. Samkara) of S. India whom he converted to Buddhism." Now De-Chye-Bdyebyed according to modern pronunciation. Dás is evidently in error in rendering De-Chye as Samkara (Wenzel).

<sup>‡</sup> Cf.—Kâmasútra of Vâtsyâyana. कर्तवी कुलाख: मानकिं: मानवाइनी सहादिशी सञ्चयकी [ज्ञान] । Referring to a "new" MS. of Harshacharita in his possession Hall remarks—"for Sălivâhana I there find Sâtavâhana"—Intro. to "Vâsavadattă." p. 54. This by implication would suggest that the other MS. had the reading Sălivâhana.

Now "the Andhrabhrityas or Sátaváhanas ruled over the Deccan from B. C. 73 to about A. D. 218, i.e., for about 3 centuries.

"The period during which they ruled over Maháráshtra must have been a prosperous one in the history of the country. Hence several traditions with regard to different kings have been preserved. But that Sáliváhana or Sátaváhana was a family name must have been forgótten and different princes of the dynasty have been confounded and identified. Thus Hemachandra in his Desikosha gives Sáliváhana, Sálana, Hála and Kuntala as the names of one individual." \*

The So-to-p'o-ho of the Chinese version of the "Friendly Epistle" has been identified with one of the Sátaváhanas or Andhra kings, possibly Yajna-Srí-Sátakarni. who seems to have reigned about 172—202 A. D. There is, therefore, nothing improbable in this particular, Sátaváhana being a contemporary of Nágárjuna. In the alchemical Tanfra, "Rasaratnákara," ascribed to Nágárjuna,

Bhandarkar's "Early History of the Deccan"-p. 36.

there is a dialogue between this sage and Sáliváhana (p. 6). We shall revert to this subject later on.

Numerous works have been fathered on Nágárjuna and it is an open question if any of them be genuine. As is well known Vyása or more properly named Vedavyása has been taken to be the compiler of not only the four Vedas but also of all the Puránas put together. Piety and credulity go hand in hand and are seldom troubled with questions of anachronism. Plato, Democritus and Geber have been held responsible for writings which ap-

Nágárjuna as a comprehe n s i v e name of the activity of Maháyánism. peared several centuries later. Names, venerable and illustrious, have often been pressed into service to lend weight

and dignity to productions which otherwise would not have commanded a respectful hearing. On the whole we are inclined to agree

In Bunyin Nanjio's Catalogue of the Bud. Tripitaka there is a list of 24 works ascribed to Nagarjuna. The Subrillekha was translated into Chinese in 434 A. D. App. pt. I, p. 368.

with Kern when he says, "The figure of Nágárjuna, so prominent in the history of the rise of Maháyánism, shows a double character. It is, on the one side, the name of an influential person, the first eminent leader of a school imbued with Hinduism and the methods of Indian scholastic philosophy. On the other hand, Nágárjuna is simply a comprehensive name of the activity of Maháyánism in the first phase of its onward course."\*

"Its civilization was then essentially Brahminical as it had come to be in a protracted struggle with Buddhism. Albériul does not know Indian Buddhism from personal experience though it had not yet entirely withdrawn from India and in some part was still a political power. (p. v.)

"The valley of the Kabul river and the Punjab are all that Albérûni has seen of India, (p. xiii.)

"The high schools of Hindu science and learning, Kasmir and Benares, were in Albèrúni's time unapproachable for Muslems. (p. xiv.)"

<sup>\*</sup> In Vol. I of this work (Intro. sciii), we quoted Alberuni as to the date of Nagarjuna. This cultured Arab, ordinarily a very trustworthy guide, derived his information from the Brahmins of that part of India from which every vestige of Buddhism had disappeared in the 11th century and he was evidently misled on this point as the traditions relating to Nagarjuna had at that distance of time become very vague. This will be clearly seen from what Prof. Sachau says in the preface to the Arabic edition of Albéruni.

háyánism began to be tinged háyánism began to be tinged more and more with Brahminical bias. A notable and decided step in this direction was taken by Asamga, a monk of Gándhára, who composed the Yogáchára-bhúmisastra, in which by assimilating the doctrines of Patañjali he paved the way for the growth of Tantras. He seems to have lived about 400 A. D.\* Vasubandhu, Asamga's younger brother, was another zea-

<sup>.</sup> C/.-Takakasu : Journ. Roy. As. Jan. Soc.1905.

A life of Vasubandhu was translated into Chinese by Paramàrtha. A. D. 557-569.-Bun. Nunj. Cata, p. 371. Csoma Korosi following the Tibetan Chronology says :- "I know that Arya Asamga lived in the sixth or seventh century after Jesus Christ," As. Res. XX, p. 513. This date has been accepted by Lassen (Ind. Alt. ii, p. 460) as also by R. Davids ( Buddhism, p. 207 ). But this chronology has now become untenable. The date of Asamga and his brother Vasubandhu should be put back by about two centuries, as some of their works were translated into Chinese in the beginning of the fifth century and perhaps earlier. (Bun. Nanj. Cata. App. i p. 371 ). It must have taken a century or two to have their works sufficiently recognised in India before they would deserve a place in the Chinese Tripitaka.

lous adherent of this school and is said to have been a teacher in the college attached to the monastery of Nálendra—the "Oxford of Indian Buddhism." From Tibetan sources we learn that the celebrated logician Dignága was a disciple of Vasubandhu, a contemporary of Lha-tho-ri, king of Tibet, who lived up to 371 A. D.\*

Maháyánism now began to adapt itself to its environments. The abGradual and imperceptible fusion of the Yoga ideas of Maháyánism with Saivaism. Inade the transition into the Tantric cult easy and Nor-

thern Buddhism began to develop and expand by entering into an alliance with Saivaism, which favoured the growth of Buddhist Tantras. The origin and development of this class of literature have been the subject of a masterly exposition by Burnouf. The Maháyánists not only set up their own deities but borrowed copiously from the pantheon of the Hindus. Thus in the Sivaite Tantras while

<sup>\*</sup> S. C. Vidyàbhúshaza: Journ. As. Soc., Vol i, (1905), p. 227.

the God Siva is the fountain of all knowledge and sciences, in their Buddhist counterparts we have the celestial, metaphysical and potential Buddhas\* occupying the same position. The worship of the female energies (Sakti) which plays such an important part in the Tantras was encouraged in the person of Tárá. The Hindu Gods and Goddesses were also objects of adoration, only they were assigned a subordinate position. The question has often been asked : why did Buddhism seek alliance with Saivaism in preference to the Vishauvite cult? The answer seems to lie in the fact that it was precisely in those parts of India where the worship of Siva, especially in its Tantric form, had struck root that Maháyánism asserted its sway; † and thus the apostles and propagators of the latter made most of the former. A few centuries later when Vaishnavism gained an ascendancy in Bengal the tables seem to have been turned. A gradual and imperceptible fusion

<sup>.</sup> i. c. the Bodhisattvas.

<sup>+</sup> Vide ante. p. xi. ( under Wema kadiphses ).

took place between the rival creeds. Thus
in the celebrated adoration in the opening
lines of Gitagovinda we find Buddha freely
acknowledged as an incarnation of Vishnu
and extolled for his abhorrence of sacrificial
rites.\*

From Fah-hian's travels we gather that in the beginning of the 5th century A. D., the Maháyánists were gaining the upper hand, though their rivals, the Hináyánists, were still holding their own in several localities. Thus at Mathurá and Pátaliputra he found the members of both the sects living side by side and having monasteries of their own.

निन्दांस यद्यविधेरण्ड श्रुतिकातम् सदयण्डदयद्शितपश्चातम् । क्षेत्रव धतबुद्धशरीर कय जगदीश चरि ॥

It is scarcely correct to assert that Buddhism was exterpated in the land of its birth by cruel persecution. Cf. Vol. i. Intro. lxvii. The Bengali poet Ramchandra Kavibharati, author of Bauddha Sataka, though a devoted Buddha, belonged to the same class of thinkers as Jayadeva. Pandit 8. P. Sástrí is inclined to place him in the latter end of the 13th century.—Journal of Buddhist Text Society, Vol. I. Pt. iii. So late as 1441 A. D. MSS. of Buddhist works used to be copied from in Magadha.—Bendali's Camb. Cata. of Bud. Sans. MSS. (1883), pref. iv.

From the fact, however, that the pious Chinese pilgrim repeats the Suramgama Sútra for his protection, we may conclude, since he is by no means a pronounced Maháyánist, that the predisposing causes for the origin of the Tantras were already in existence. "In this Sútra is contained the most complete list of Dharanis (invocations) found in any Chinese compilation. There are 426 distinct sections containing the names of the different Buddhas and Hindu deities worshipped at the time of the composition of the Sútra. Considering that Fah-hian in the early part of the 5th century regarded this book with reverence. . . . . . We may reasonably assign it to a period not later than the end of the 1st century. Now amongst the invocations we find distinct reference to Dhyání Buddha, Vairochana, Akshobhya, Amitábha and others shewing that they were coming to be recognised and worshipped even at that early date." \*

<sup>·</sup> Intro. to Beal's "Fah-hian." (Lxxii).

These Dháranís may be looked upon as the precursors of the Tantras Dháranis as the precursors of the and they fully support the views that when they were composed Buddhism had turned a new leaf. The repeating of certain magic formulas along with the names of Buddha Amitabha. etc., was to secure salvation, in other words, "instead of the old doctrine [ of Karman ]as a man soweth, so he shall reap-a new and easier way of salvation is here preached, viz., as a man prayeth, so he shall be saved. It is what is known to us as salvation by faith rather than by works..... It would almost seem as if this popular and easy doctrine had secured to itself the name of Mahayana, as meaning the Broad Way, in opposition to the Narrow Way, the Hinavána.\*

The new class of literature which now arose in order to meet the demands of the Maháyánist revival is collectively known as

Max Müller, Buddhist Mahàyana Sutras. Intro. to larger Sukhavati-Vyùha, ix . S. B. E. Series, Vol. xlix.

the Vaipulya Sútras or the Sútras of the

developed school, of which
the Dháranis are an integral
part. It found expression in such works as
the "Saddharmapundaríka," "Lalitavistara,"
"Tathágataguhyaka," "Prajňápáramitá,"etc.,
—all of which soon acquired almost canonical
sanctity in the estimation of the N. Buddhists.
Burnouf has tried hard to differentiate
between the simple Sútras as represented by
the literature of the primitive orthodox Buddhism and the expanded Sútras of which the
distinguishing mark is the occurrence of Bodhisattvas.\* This drawing of hard and fast

<sup>• &</sup>quot;La prèsence des Bodhisattyas ou leur-absence intéresse donc le fonds même des livres où on la remarque, et il est bien évident que ce seul point trace une ligne de démarcation profonde entre les Sútras ordinaires et les Sútras développès. —Burnouf, Intro. p, 112; ibid, p. 120. Ed. 1844. Vide Max Muller's remarks at the end of the Smaller Sukhàvati-Vyúha, p, 102, S. B. E. Series, Vol. xlix.

Cf. also "Some Vaipulyss are, materially, much like the old Sútras, whole passages e. g. of Lalita-Vistara recur almost word for word in the Pàli Scriptures." Kern (Ind. Bud. p. 5). This eminent Buddhist scholar also very appositely re-

lines has been found to be well-nigh untenable.

By the second century A. D. we find the leading beliefs and ideas as crystallised in the Maháyána literature fully in vogue. Thus we

marks elsewhere: "The results arrived at by Burnouf may be right so far as Mahávaipulya Sútra as a whole is concerned, they cannot be applied to all the component parts of such a work. Not to go further than the Saddh, and the L. Vistara, it can hardly be questioned that these works contain parts of very different dates, and from various sources."—Kern, Intro. to Saddh, pp. x-xi. Passages in L. Y. are literally identical with those in Mahávagga. Again:—"These few examples I have chosen will suffice to prove that the material of a Mahávaipulya Sútra is partly as old as that of any other sacred book of the Buddhists."—Ibid., xiv.

• The truth seems to be that "the historical relation between the Hinayana and the Mahayana schools of Buddhism is to me as great a puzzle as ever."—Max Muller, Intro. to L. Sukh. Vyūha, ix. Even the very distinction between the N. and the S. Buddhism has been taken strong exception to by R. Davids, who says:—"There is not now and never has been, any unity either of opinion or of language in what is called northern, or in what is called southern Buddhism. There is a distinct disadvantage in continually suggesting a unity which has no existence in fact. In a word the current division of Buddhist literature into northern and southern is entirely unscientific, and misleading."—Bud. India, p. 173.

come across in the "Buddhacharita" of Asvaghosha, who is admitted on all hands to be a contemporary of Kanishka, such a passage as this: "this, Sirs, is the Mahá-yána, the instrument of the law of the perfect Buddha, which is the establisher of the welfare of all beings, set forth by all the Buddhas."\* The "Lotus of good Law" was translated into Chinese at the close of the second century A. D. †

Side by side with the growth of the scriptures another class of literature was called Buddhistic Taninto being by the exigencies of the times—we mean the Tantras, the necessity for which has been hinted at in the first volume. ‡ However esoteric may be the doctrines sought to be conveyed through the medium of these productions, it would be idle to deny that there

<sup>\*</sup> Cowell's trans. p. 184. S. B. E. Series, Vol. xlix.

<sup>+</sup> Edkin's "Chinese Buddhism," p. 89. There were several versions of this sacred book.—Vide Kern's Intro. p. xxiii (S. B. E. Series).

<sup>†</sup> Vol. i. Intro. lxx.

der to the baser instincts of frail humanity. At what particular time these Tantras appeared on the scene is yet a matter of conjecture, but the views of Wilson which held the ground for more than 30 years have now been found to be erroneous. Evidence is now forthcoming from quite an unexpected source, which goes to prove that Buddhist Tantras existed as early as the fifth or sixth century A. D., if not earlier. \* If Buddhist Tantras, again, pre-suppose the existence of Hindu Tantras, one need not be considered as rash in assigning an earlier age to the latter. †

<sup>\*</sup>Vide the palm-leaf MSS, discovered in the monastery of Horiuzi in Japan and carried from Central India. One of these is in the handwriting of a famous Chinese priest, named Kanshin, who came to Japan in A. D. 753. The MS, contains besides a Dhárani, five Tantras. "Bud, Texts from Japan," ed. by Max Muller, Vol. i, pt. i, Intro, pp. 6-8. It is fair to conclude that these Tantras existed in the land of their birth at least two centuries earlier.

<sup>†</sup> Waddel says:—"No one has yet realised the vast extent to which Maháyána and Tántrio Buddhist remains cover Iudia; nor sufficiently realised the leading part played by the Maháyána in Indian Buddhism during its popular period," Journal of the Roy. As. Soc. (1894).

The Tantras found a congenial home in China. Amoghavagra, a Sramana of northern India and a Brahmin by caste resided in the Celestial Empire for several years between 746 and 771 A. D., and under his influence the Tántric doctrines dealing with talismanic forms and professions of supernatural power first gained currency there.\* Hence long before his time Tantras must have been popular in India. From the eighth to the eleventh century A. D. we are in possession of authentic records as regards the pre-

valence of Tantras in Northern
India; as it was about this
period that several of these
were gradually imported into Tibet by Indian
Pandits, but they must have been composed
much earlier. †

<sup>\*</sup> Bun, Nanjio's Cata, App. ii, p. 445. Amoghavagra translated 77 works including Ushmisha-chakravarti-tantra. Garudagarbhaga-tantra and Vagrakumára-tantra.

Cf.—Also "The existence of the Tantra Sástras may thus apparently be traced at least as far back as the 6th century A. D."—Vide "Annual Report," As. Soc. Beng. 1906.

<sup>†</sup> In the first half of the eighth century two eminent

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Atisa gave a fresh impetus to Tantrism in the land of snow. From the analysis of Mdo by Csoma we also come to know in detail the names with the dates of the Indian scholars who with the aid of the local interpreters (lochavas) rendered into Tibetan the various Sanskrit Tantras. The faithful accuracy with which these translations were made and their fidelity to the original enable us often to reproduce the Sanskrit Texts and thus we are in possesion of valuable histori-

Pandits of Bengal visited Tibet at the invitation of its king and formally introduced there Buddhism; these Pandits were Santi Rakshita, high priest of the monastery of Nálenda and his co-adjutor Padma Sambhava, a native of Udyana, who took charge of the Tantric part of the Buddhist liturgy. They were followed by the sage Dípamkara-Srí-jnána (Atisa), b. A. D. 980, d. 1053. He acquired proficiency in the three pifakas of the four classes of the Hínayána Srávakas, in the Vaiseshika philosophy, in the three pifakas of the Maháyána doctrine, the metaphysics of the Mádhyamika and the Yogáchárya schools and the four classes of the Tantras. At the request of king Naya Pála he sceepted the post of high priest of the monastery of Vikramarila.—Vide S. C. Dás,—Journal of the Buddhist Text Soc. Pt. i.

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cal data.\* Some of these Tantras deal with alchemy and their contents reveal to us the knowledge of chemical processes in India from about the 6th to the 8th century A. D.†

Fortunately we are not dependent upon the Tibetan Tantras alone for gaining an insight into this dark recess in Rasaratnákara. the history of Hindu intellectual activity. In the course of our search

Speaking of the Tibetan translation of Asvaghosha's Buddha-Charita, Cowell remarks: "The Tibetan version appears to be much closer to the original Sanskrit than the Chinese; in fact from its verbal accuracy we can often reproduce the exact words of the original, since Sanskrit words are always represented by the same Tibetan equivalents, as for instance the prepositions prefixed to verbal roots."—I. c. Intro. p. x. Waddel is equally impressed with the "profoundly accurate and scholarly nature of the Lámaist translations of Sanskrit Buddhist books;" and he again observes: "It is clear that the Tántrie and Maháyána features of Lámaism were imported en bloc from Indian Buddhism,"—Journal of the Royal As, Soc. for 1894, p. 15.

<sup>†</sup> Analysis of the contents of the Mdo (Sútra) by Csoma de Korosi—Asiatic Researches, XX (1836), p. 583. "A work on preparing quicksilver, the most powerful for subduing every sickness and for improving the vigor of the body."

—"A work on turning base metals into gold," We are thus reminded of the contents of the Rasárwava and the Rasaratnákara, Vide p. 2.

for MSS, of alchemical Tantras we have come upon a precious find, in the shape of a Buddhist Tantra, with Nagarjuna as its reputed author. Of alchemical Tantras we have had enough and to spare; but there is great difficulty in assigning dates to them, as they one and all pretend to emanate from the mouth of the God Siva himself. We are only left to internal evidences-evidences based upon the gradual evolution of chemical processes, which we have not been slow to take advantage of. The MS. in question is a mere fragment, but it is calculated to evoke all the zeal and en-Its historical thusiasm of a Palæontoloimportance. gist-of an Owen or a Marsh-in his efforts to restore an animal and assign to it its preper place in the economy of the laws of evolution, when he luckily chances upon a fossil impression of its tooth or claws. From this point of view Rasaratnákara, for such is the name of our MS., is of uncommon interest. It is a Tantra of the Maháyánist school and as such its invocations are

addressed to all the Buddhas ;\* and in one place there is a pointed reference to Prajňápáramitá †(perfection of wisdom) appearing before Nágárjuna in a dream and revealing to him chemicel knowledge.;

A noteworthy feature of this work is that some chemical processes are discussed in the form of a dialogue between Sáliváhana and Nágárjuna, and Ratnaghosha and Mándavya.§ These last two names are held equally in veneration with Nágárjuna and grateful acknowledgments to their services occur in some later chemical treatises.¶ The bringing together of these four dramatis persona.

<sup>\*</sup> प्रशिष्टमा सुर्व्यवृद्धान् । Cf. The opening invocation in the Sukhávatí Vyúha: ची नम: श्रीस्थ्यवृद्धवीधिस्थ्येथ: । also नम: प्रशेकवृद्ध चार्वयावकाषाम् नमी वीधिस्थ्यानाम् in A'rya Mañjusrímúla Tantra.—Vide As. Res. xx, p. 512.

<sup>†</sup> Cf.—The invocation in Vagrachchhedika नमी सगवत्या पार्थपद्यारमिताधे.

I Vide Sans. Texts, p. 10, also Trans., p. 5.

<sup>§</sup> Vide Sans. Texts, pp. 12-14, also Trans., pp. 6-8.

<sup>¶</sup> Cf. Vol. i, p. 77.

especially of the first two has a significance of its own. We have already seen that references to Nágárjuna and his contemporary king Sáliváhana are only to be met with in ancient classical literature (vide ante xxii). It seems probable that Rasaratnákara was written at a time when the memory of these personages was still fragrant. Judging from internal evidences also we come to the conclusion that it is one of the earliest works extant on the subject. In our attempt at throwing light on the text of Rasárnava, we had to quote several parallel passages from it, and from a careful perusal of both we are

Also a typical production of the Maháyánist period of intellectual activity. of opinion that the latter is the inspirer rather than the borrower. Rasaratnákara, in short, seems to us to be a

typical production representing the Maháyánist period of intellectual activity and we may not be wide of the mark if we put down 7th or 8th century A. D. as its latest date.

<sup>\*</sup> Vide Vol. i, Sans. Texts, pp. 7, 12, 13 and 18.

From the 5th to the 11th century A. D. the colleges in connection with the monasteries of Pátaliputra, Nálandá, Vikramasila, Udandpura, etc., were the great seats of learning as the temples attached to the pyramids in ancient Egypt; and alchemy was included in the curricula of studies.\*

The existence of a vast ancient Tántric Antiquity of Alliterature with alchemy as a component part has now been placed beyond doubt, thanks to the searching examination of the Mahárájá's collection of valuable MSS. of Nepal by the eminent scholar's Bendall, H. P. Sastrí and S. Lévi. Of surpassing interest is the discovery of a Tantra belonging to the extinct school Kubjikámata, written in Gupta character and copied about the sixth century A. D. This

school, though itself very ancient, presupposes the existence of other schools and we have distinct mention the Maháof yána.\* We now learn that the gradual fusion and amalgamation of Sivaite and Buddhist Tantras had begun even anterior to the sixth century. The Kubjiká-tantra was evidently composed outside India proper, probably in Nepal. The Goddess Párvatí encourages her consort to proceed to the continent for the spread of the tenets propounded by it. † In one place we come across a passage t in which Siva himself speaks of párada (mercury) as his generative prin-

दिच्ची देवयानी तु पिळयानस्त्रीभरी।
सम्बन्धी तु सद्दावानं शिवसंत्रा प्रजीवते॥
† सम्बन्ध लंभारते वर्षेऽधिकाराय सम्बतः।
‡ सदीर्थः पारदी यद पतितः स्कृटितं स्विः॥
सदीर्थेच प्रततासे तावार्थां सन्ते विः।

तिष्ठनि संस्कृताः सनः भक्षा पङ्विप्रजारयाम् ।

For the passages cited here we are indebted to the industry and courtesy of Pandit H. P. Sastri, who has wended his way through the bulky MS.

Catalogue of Palm-leaf and selected paper MSS. belonging to the Durbar Library, Nepal, by H. P. Sastri (1905).
 lxxviii, et. seg.

ciple and eulogises its efficacy when it has been killed six times.\* We also find allusions to the transmutation of copper into gold with the aid of mercury. In short, we have ample references to alchemical processes described in the very technical terms in which Rasárnava, Rasaratnákara and other typical works of the Tántric period abound. †

chapter with an extract from the work of an eminent Bud-dhologist with this reservation that the growing influence of Tantrism began as we have seen long before the 8th century.

"The decline of Buddhism in India from the 8th century downwards nearly coincides with the

For the the meaning of the word at (Vedha) see this Vol. p. 18, footnote, also Vol. i, p. 120.

<sup>\*</sup> Even at the present day mercury, which has been killed six times in succession, each time with an equal weight of sulphur us qualities; is reputed to be one of the most potent of remedies.

<sup>†</sup> ८.८. पर्श्वन विद्वितो वेध: किंब्यचतीन विद्यते। रशक्तिं ययातासंन भूथमासर्वाद्रजीत्॥

growing influence of Tantrism and sorcery, which stand to each other in the relation of theory to practice. The development of Tantrism is a feature that Buddhism and Hinduism in their later phases have in common. The object of Hindu Tantrism is the acquisition of wealth, mundane enjoyments, rewards for moral actions, deliverance, by worshipping Durgā, the Sakti of Siva-Prajūā in the terminology of the Mahāyānathrough means of spells, muttered prayers, Samádhi, offerings, etc. Similarly the Buddhist Tantras purpose to teach the adepts how by a supernatural way to acquire desired objects, either of a material nature, as the clixir of longevity, invulnerability, invisibility, alchemy; or of a more spiritual character as the power of evoking a Buddha or a Bodhisattva to solve a doubt, or the power of achieving in this life the union with some divinity. There is an unmistakable affinity between Tantrism on one side, and the system of Yoga and Kammatthana on the other. Tantrism is, so to say, a popularised and, at the same time. degraded form of Yoga, because the objects are commonly of a coarser character, and the practices partly more childish partly more revolting.

"Tārānātha informs us that Tantrism existed and was transmitted in an occult manner in the period between Asanga and Dharmakirti, but that after Dharmakirti's times the Anuttarayoga became more and more general and influential. Substantially his statement is certainly right. He adds that during the reign of the Pāla dynasty, there were many masters of magic, Mantra-Vajrāchāryas, who, being possessed of various Siddhis, performed the most prodigious feats.

"The kings of the Pāla dynasty, whose sway over Gauda and the adjacent regions lasted from about A. D. 800 to 1050, are known both from the annals and their inscriptions as protectors of the Faith. It was during that period that the monastery of Vikramasīla was a renowned centre of Tantrist learning.

"The Sena kings, who followed the Pālas in the dominion over Eastern India, though belonging to a Hindu persuasion, were not hostile to the Faith. Still Buddhism declined during their reign and more so after the invasion of the country by the Muhammedans in A. D. 1200. The monasteries of Udandapura and Vikramasīla were destroyed; the monks were killed or fled to other countries. The learned Sākyasrī went to Orissa, and afterwards to Tibet; Ratnarakshita to Nepāl; Buddhamitra and others sought a refuge in S. India, whilst Sangama-Srījūāna with several of his followers betook themselves to Burma, Camboja, etc.

And thus the Law of Buddha became extinct in Magadha.

"Many emigrants from Magadha rejoined their brethren in the South and founded colleges on a modest scale in Vijayanagara, Kalinga, and Konkan. The comparatively satisfactory condition of Buddhism in Dekkan about that time is attested by the rich donations to the monastery at Dambal."

It will be noted that the monks of the monasteries of Udandapura and Vikramsila on their dispersion carried with them their learning and arts in the same manner of the

Spread of alexpulsion from Constantinople
bore with them their intellectual treasuries to
the Italian cities. In the kingdom of the
Deccan and in Tibet the Buddhist refugees
found hospitable asylums, † just as the Greek
Philosophers did in the Florentine Republic
under the Medicii.

Kern-Manual of Ind. Bud., pp. 133-134.

<sup>†</sup> Cr.—"The Deccan, which from the eleventh century was the refuge and centre of literary activity generally. In Hindustan it had been substantially arrested by the inroads and ravages of the Muhammadans,—Weber. Hist. Ind. lit. p. 283.

Some eminent orientalists, whose opinions naturally carry weight, have hitherto taken for granted that the knowledge of chemistry such as we find reflected in the Tantras quoted by Mádhava in Rasesvaradarsana\* was derived by intercourse with the Arabs.†

<sup>.</sup> Vol. i, Intro, Ixxviii, et seg.

<sup>†</sup> E.g. Barth : "In regard to alchemy, anyhow in which the Sittars are zealous adepts, they were disciples of the Arabians, although other Sivaites had preceded them in the pursuit of the philosopher's stone. Already, in his exposition of the different doctrines of the Saivas, Sayana thought he ought to dedicate a special chapter to the Rasesvara-darsana or "system of mercury," a strange amalgamation of Vedantism and al-chemy. The object contemplated in this system is the transmutation of the body into an incorruptible substance by means of rasapána, i.e., the absorption into it of elixirs compounded principally of mercury and mics, that is to say, of the very essential qualities of Siva and Gauri, with whom the subject of the operation is thus at length identified. This species of transubstantiation constitutes the jivanmukti, or state of deliverance commencing with this present life, the sole and indispensable condition of salvation. It is clear that the devotional formulæ of the Vedanta are here only a sort of jargon, under which there lies hid a radically impious doctrine; and it is not less clear that in this doctrine, which had from the fourteenth century produced a rather considerable literature, there is an infusion of Mohammedan ideas. these sheres in the character of travellers or merchants, and had established commercial relations and intercourse with these parts long before the Afghans, Turks, or Mongols, their coreligionists, came as conquerors."-"Religions of India," ed. 1891, pp. 210-211.

The attentive reader who has followed us In Tibet and the all along could not have failed to notice that it was in the Universities of Nálendá, Udandapura and Vikramasila, in Central India and Magadha, precisely the regions which were cut off from communication with the external world, that Tantric mysticism with alchemy as an integral part was cultivated and from thence spread to Bhot (Tibet) and the regions lying to the south-east of it, and South India.†

<sup>\*</sup> See under colophons to Rasahridaya and Rasasára respectively.

<sup>†</sup> The last rallying point of Hindu learning and sciences was the kingdom of Vijayanagara, which was in the heyday of its glory under Bukka I (A. D. 1354-1371) with Madhava as his prime Minister. Wilson says:—"The history of Vijayanagara is a subject of considerable interest in the annals of India, as the last barrier that was opposed to Muhammedan invasions, and that preserved the southern part of the Peninsula from foreign rule until a very modern period,"—As. Res., Vol. xx (1830), p. 1. See also Sewell's "A Forgotten Empire"—(Vijayanagara).

## CHAPTER II.

Having thus far prepared the ground for believing that alchemy along with other cognate branches of learning was the outcome of Indian intellectual activity, we shall now proceed to follow it up with its further development. At the outset it is, Further cultivation of alchemy. however, necessary to remember that on the decline of Buddhism the vigorous impetus which its followers gave to literature and science was not lost to India. Nay, during and after the revival of Brahminism under the Gupta dynasty and its successions we have some mighty intellectual giants whose productions will continue to shed lustre as long as the Hindu nation exists. Kálidása and Bhavabhúti, Brahma Gupta and Aryabhatta, Samkara and Rámánnja are names which may be regarded as the heritage not of India alone but of the entire civilized world. At the time of the Brahminic revival Buddhist works of acknowledged merit far from

being cast aside were held in veneration. Amarasimha in his Lexicon and Vágbhata in his Ashtámgahridaya \* as also the pseudo-Vágbhata \* commence with an invocation to Buddha, which has never shocked the tolerant spirit of the Hindu. Charaka and Susruta also bear distinct impress of Buddhist retouching. The Buddhist Trantras became likewise a part and parcel of Hindu religio-philosophical literature, † the subject-matter

Buddhist alchemicel Tantras absorbed into fliddu
Tantras.

Of the former was incorporated into the latter, the names
of Tává, Prajūápáramitá and
Buddha being simply changed into those of
Párvatí and Siva. In Rasaratnákara itself
we have distinct indications that it is an
admixture of both.

Vol. i, p. 76.

<sup>†</sup> Speaking of a typical Buddhist production belonging to this category Burnouf 'observes: "Ce morceau est exclusivement spéculatif, et il nous offre une nouvelle preuve de l'alliance intime que le système des Tantras a contractée avec la philosophie buddhique la plus elevée" (l. c. p. 543 ed. 1844),

It should thus be understood that the works under review in this chapter are based upon their Buddhist counterparts; in short, there is no disposition to ignore the debt of obligation the authors are under to Nágárjuna, Ratnaghosha, Mándavya and others.

In the introduction to the first volume we stated: "It is to be regretted that the several works quoted by Mádhava [on the science

of mercury ] Rasárwava alone seems to have survived to our days" (l. c. lxxxiii). Since then we have been fortunate enough to procure as many as three transcripts of MSS, of Rasahridaya by Govindabhagavat from different quarters. As Mádhava speaks of this author in terms of the deepest reverence and regards him as "ancient," \*we think we should not erron the wrong side if we place the author some three

<sup>·</sup> Cf. Vol. i, Intro. lxxx.

तत्त्रपश्चम् गीविन्दभगवत्पादाचार्यसर्भश्चरामेश्वरभद्दारकः श्विकः प्राचीनेराचार्योनं कपितः।

The qualifying epithet wave is only applied to venerable Rishis of old.

centuries before his time. If our surmise be correct, he should have lived about eleventh century A. D. The only personal allusion which the author has condescended to offer for the edification of posterity is that he wrote his book at the request of the king of the Kirátaland, i.e., the region adjoining modern Bhotan. Portions of this remarkable treatise after a careful collation of the MSS. have been reproduced in the proper place. The worm-eaten fragmentary MS. produced from Benares is 386 years old. Internal evidence equally goes to establish the antiquity of this work. The author was evidently a Buddhist as we learn from the colophon to the Benares MS. (vide trans. p. 12). It is, however, not to be found either in the India office or the Nepál MS. This important omission is easily accounted for. It is the reluctance of the latter day Hindus to acknowledge their obligations to a Buddhist author.

Rasárnava which has been noticed at length in the first volume and to which was assigned the 12th century A. D., as also Rasaratnasamuchchaya (13th to 14th century), need not further arrest our attention.

The presentation of the various treatises of the Tantric and iatro-chemical periods under discussion in their exact chronological sequence is not an easy task; in the absence of more definite information, we are afraid, we shall now and then have to hazard a conjecture.

The introductory lines of Books viii and ix of Rasaratnasmuchchaya, in which Somadeva is mentioned as the author of the descriptive part, led us to suspect that they are merely reproductions from "a standard work on the subject by Somadeva, no longer extant." Our surmise has proved to be Rasendrachūdi- partially correct. We have at last been able to recover the supposed lost work. A transcript of a MS. of Rasendrachūdāmani by Somadeva, preserved in the Library of the Deccan College, Poona, reveals to us the fact that

<sup>.</sup> Vol. i, p. 118.

practically all the important portions of this book have been woven into the text of Rasaratnasamuchchaya; and this gives us an additional opportunity of collating many doubtful passages in both. But the present work itself does not lay claim to originality. It makes a candid admission that it culls all its materials from pre-existing chemical treatises.\* It further puts forward the alchemist Nandi as the inventor of the process of sublimation and of the Koshthi apparatus (Vol. i, pp. 69 and 89).† Nágárjuna, Dandi, Sambhu and the sage Brahmajyoti are also spoken of as sources of his inspiration. We get very little inkling into the personal history of Somadeva, except that he was the ruler of a city named Karaválabhairava. Thefact that R. R. S. lays Rasendrachudámani so amply under contribution would suggest that the latter had become somewhat rare

or that its contents had been well-nigh forgotten when the former was compiled. Its date may therefore be put down between the 12th and 13th centuries A. D.

Another important work of this period is Rasaprakása-sudhákara by Yasodhara. The author of R. R. S. in the opening lines mentions the names of 27 alchemists to whom he is beholden, among which occurs that of Yasodhana. We have little doubt that the correct reading is Yasodhara. Rasaprakiessudhákara. We now find that there is very little original matter in R. R. S., it being made up of citations from Rasarnava and the works of Somadeva and Yasodhara. We should not, however, be understood to retract the high encomiums we thought fit to bestow upon R. R. S. for "its methodical and scientific arrangements of the subject-matter, which would do credit to any modern work."\* Its author has never laid claims to originality. but, on the contrary, has freely acknowledged the sources he drew upon. The student of

<sup>·</sup> Vol. i, Intro. lxxxvi.

Hindu chemistry, however, like a weary but devout pilgrim, must wind his way through intricate and thorny paths and feel ineffable jos at being able to approach the original fountain undefiled. It now transpires that the credit for the accurate observations on the metallurgy of zinc (Vol. i., pp. 88 & 156) really belongs to Yasodhara. While the author of B. R. S. always scrupulously admits that his work is a mere compilation, Yasodhara, on the other hand, is anxious to let the world know that the processes he describes have been verified by experiments performed with his own hands. Among the authorities he cites are Nágárjuna, Devisástra (probably Rasárnava), Nandi, Somadeva, Svachchhandabhairava and Manthanabhairava. As Yasodhara quotes Somadeva, he must have been posterior to the latter by at least a hundred

<sup>\*</sup> Of सहस्रोन क्षतं सम्यक् जारयं न युवं सया । स्वहस्रोन भवशीनि क्षतं सम्यक् युतिन हि ॥ धातुवश्यकृतीयीऽसी स्वहस्रोन क्षतो सया । इष्टमत्वययीगीऽसी कवितो नाच संगयः ॥

years and he should therefore be placed in the 13th century A. D. \*

Rasakalpa likewise seems to belong to this period. It is in the shape of Rasakalpa. a Tantra, but curiously enough it is not much troubled with consistency. In the opening salutation Siva, "the king of mercurial lore" and his consort Chandiká are reverentially bowed to-a procedure scarcely reconcilable with the position of a revealed document. The colophon at the end of each Chapter ( उज्जाम ) claims the work to be a part and parcel of Rudrayámala "antra; at the same time due acknowledgment is made to the contributions of Govinda, the author of Rasa. hridaya, Svachchhandabhairava and other adepts.† Towards the end the author says : "The processes described have all been verified by me and not borrowed at secondhand from my teachers." Needless to add here that the God Siva would not have

We are using a copy of the MS. preserved in the Runbir Library, Kásmír. The readings are on the whole accurate.

<sup>†</sup> E.g. सन्तापाळॅबदीरिताः।

been at pains in justifying the necessity of his production with such a timorous apology. From internal evidence it is abundantly clear that it could not have been composed earlier than the 13th century A.D.

As the author has confined himself solely to a description of the metals, minerals and the processes of "killing" them with the agency of various apparatus and has not gone into the treatment of diseases with the aid of mineral preparations, he has been able to condense much important information within the narrow compass of a few short chapters.

Rasarájalakshmí also deserves some prominence here not because of its intrinsiz

Rasarájalakahmi. worth but because of the references to previous Tantras and alchemists, amongst which are Rasárnava, Kákachandísvara, Nágárjuna, Vyádi, Svachchhanda, Dámodara, Vásudeva and Bhagabat Govinda. We have also categorical mention of the purely Ayurvedic works such

as Charaka, Susruta, Háríta and Vágbhata, to which our author is equally indebted.\* From the colophon to the MS. procured from Benares we learn that the author Vishnudeva was Court Physician to king Bukka.† If this statement be accepted—and prima facie there is no reason to question it—this treatise must have been compiled in the latter part of the 14th century. Internal evidence equally supports this date.

<sup>.</sup> Vide Sanskrit Texts, pp. 80-81.

<sup>+</sup> Vide ante., footnote, xlix.

## CHAPTER III.

## c. 1350 A. D.

We now proceed to examine the contents of another series of works belonging also to the Iatro-Chemical period; the one characteristic feature of which is that opium is recognised as an official drug in the materia medica portion. These may be taken to date from the middle of the 14th century A. D.

Rasanakshatramáliká by Mathanasimha, physician to the king of Malwa, should find a place in this chapter. For particulars as to the contents the reader may consult p. 22. The date given by the copyist of the MS. is Samvat 1557 i.e. 1500 A. D. The work itself is therefore older.

Rasaratnákara by Siddha Nityanátha, son of Párvati, comes under this Rasaratnákara by category.\* The author gives the sources of his information and explains the object of his compila-

Two editions of this somewhat voluminous work have been published—one by Ganesa Chandra Ghose (Calcutta).

tion in the following words: "Whatever has been revealed by Siva in Rasárnava under the preparations of mercury; the Dipiká of Rasamamgala on mercury; all that has been said by Nágárjuna for the benefit of people afflicted with diseases, as also by Siddha Charpati, by Vágbhata and Susruta,-all these and many other treatises on mercury and minerals being consulted, I have, after rejecting the drugs and medicaments which have become rare and difficult to procure, put together [in my work] the essential features thereof. . . that I have learned from my teachers and have been in a position to subject to practical tests has been incorporated into my work for the benefit of mankind." In addition to the authorities cited above Nityanátha quotes from Chakrapáni and Rasendrachúdámani (ante liv).

the other at the "Venkatesvara Press" (Bombay). We have compared the readings of these two editions with the MS. in the Library of the Sanskrit College, Calcutta. They agree fairly well.

Rasendrachintámani will next claim our attention. We have before Rasendrachintáus the printed copy, edited by mani. Umesa Chandra Sena Gupta, late librarian, Sanskrit College, Calcutta, in which the text has been adopted, as the editor informs us in the preface, after collation of 3 or 4 MSS. We have carefully gone over this edition and compared its readings with those of a MS procured from Benares and another from the Runbir Library, Kásmír. All these agree in the main, but there happen to be certain omissions and additions, which form an interesting chapter in the history of interpolations in the literature of this description. To begin with : there is a dispute over its very authorship. Some MSS. ascribe itto Dhundhukanátha, disciple of Kálanátha, others to Rámachandra. After the customary salutation there occur two couplets in the Calcutta edition, which are not met with in the Benares and Kásmir exemplars. In these the author is made to justify his raison d'etre for undertaking his task in these words :

"I shall give publicity only to such processes as I have been able to verify by my own experiments." Such protestations have already been noticed more than once. In another place we have : "Those mercurial operations alone have found a place in my book, which I have been able to put to tests. Those who teach without being able to perform experiments labour in vain." This last couplet is quite out of place as it hangs like a tail to a long extract from Rasárnava and is in fact conspicuous by its absence in the Benares and Kasmir MSS.+ For the second time we find calomel designated as Rasakarpúra (lit. camphor of mercury; vide vol. i, p. 250). This preparation no doubt occurs in the older

<sup>\*</sup>Such pretentions put forth on behalf of the author, especially in the first person singular, lead one to suspect that they are later interpolations. In the Arabian alchemy Geber is often made to declare to the same effect: e.g. "J'ai expèrimenté moimème tout ce que je rapporte."—Berthelot, "La Chimie au moyen A'ge," t, 1, p. 338. The well known egoistic couplet in Susruta, Ch. i, पूर्व दि पञ्चलियादिदेव: is generally regarded as an interpolation.

<sup>†</sup> The extract commences with लं भावा सर्वभ्वार्गा.

works, r. g. Rasárnava; but it is described there as the white "ash" of mercury (svetabhasma). The recipé for calomel as given in the Calcutta edition, however, is quite different from that in the Benares and Kásmír MSS, and it is altogether wanting in one of the MSS, in the Calcutta Sanskrit College Library. We are therefore not without suspicion that it has been foisted into the original composition. The author refers to Rasárnava, Nágárjuna, Govinda, Nityanátha, Siddha Lakshmísvara, Trivikramabhatta and Chakrapáni. There is a lengthy colophon but no direct information can be derived from it as to the age of the author.

Rasasára: It is a comprehensive but purely chemical work dealing with 18 operations on mercury; various chemical processes are incidentally described, a good many of which, however, overlap each other. There does not seem to be any justification for coining a multiplicity of technical jargons to connote each of these. But prolixity was never regarded in the light of a vice by the

alchemical writers of the middle ages either in India or in Europe. The contents of Rasasára often remind us of a poem on alchemy by George Ripley, canon of Bridlington in Yorkshire (b. about 1460), of which Rodwell says:—

"But we cannot point to a new fact which he clucidated. He divided all chemical operations into twelve processes—calcination, dissolution, separation, conjunction, putrefaction, congelation, cibation, sublimation, fermentation, exaltation, multiplication and projection. Several MS. copies of his poem exist in the British Museum, bound up with copies of the works of Roger Bacon and earlier writers. Here is a specimen of his rugged rhymes:—

The first chapter shall be of natural Calcination; The second of Dyssolution, secret and phylosophycall;

The third of our elementall Separation;
The fourth of Conjunction matrimoniall;
The fyfth of Putrefaction then followe shall:
Of Congelation Albyficative shall be the Sixt,
Then of Cybation, the seventh shall follow
next."

Vide "Birth of Chemistry".

The author, Govindáchárya, as a devout Hindu, begins with his adoration of Siva and Vishau and tells us at the outset that his treatise is a compilation and epitome based upon standard works on the subject and the contributions of the adepts. We have every reason to be thankful to him for the many hints he throws on the sources of his information. Of surpassing interest is his declaration that for a knowledge of certain processes he is indebted to the Buddhists of Tibet. This must be taken to mean that the cultivation of alchemy had become neglected and almost forgotten in India proper and the earnest searchers for this lore had to repair during the time of our author to Tibet. Confirmatory evidence to this effect is equally

## एवं बीदा विकानित भाटदेशनिवासिन: ।

Towards the close of his work the author again acknowledges bis obligation to the Buddhists.

### दौडमतं तथा जाला रहसार: इती मधा।

We have in our possession five transcripts of the MSS, of Rasasára procured from the Libraries of Kásmír, Tanjore, Ulwar, Madras and the Temple of the Goddess Kálí, at Ramná, near Dacca, Bengal.

furnished in the colophon to Rasahridaya (trans. p. 12). During the decadence of Buddhism and the corresponding ascendancy of Brahminism in Bengal, say about the 11th to 13th centuries A.D., this branch of science also found a safe retreat in the land of the Kirátas as we have already seen. Burnell, under the influence of his preconceived notion, namely that Indian alchemy owed its origin to the Arabs, very naively remarks: "By Bauddhas he (the author) probably means the Muhammedans (of the vernacular Malayálam use of the word), though studies of this nature were much pursued by the later Buddhists."\*

Some idea of the date of Rasasára may be formed from the fact that there is mention of opium in it. But our author was evidently quite in the dark as to its origin; for, says he: "There are 4 different kinds of poisonous

Catalogue of the Taujore Palace MSS, pt. 1, p. 70.
 Burnell draws his conclusions from the reference to Buddhists in the colophon; but we have quoted above another passage in which distinct mention is made of the Buddhists of Tibet.

sea-fish, and it is from their foam that 4 different kinds of opium are derived, namely, white, red, black and yellow; while others maintain that it is derived from the foam of the snake and it is very properly used for chemical operation," • e. g.,—killing and fixation of mercury. From the context it is, however, doubtful if the narcotic drug is really alluded to here. But independently of the use of this term we may safely place this work in the 13th century A. D.

\* समुद्र चैव जायने विषयस्थायतुर्विधाः । तेम्बः खेन समुत्यतम् चिष्ठिनी विधं स चतुर्विधं । वैचिददिन सर्पायां केनं स्वाद्दिकेनकं । यथा—भारयं चेतवचे च रक्तवचे च जारकं । सारयं पीतवये च क्रचावचं च मारयं । विषविद्रसमं केनं युक्यते रसक्यंदि ।

The Sanskrit word for opium, "ahiphens," lit., foam of the snake, is of modern date. It is generally held that this word has been Sanskritised from the Arabic "aphiyun."

These indentical distichs also occur in the commentary on Sarngadhara by A'dāamalla with the additional line, ব্যবস: (আভান:) থীব্ৰিমীশ:, namely, it is the milky juice of poppy; proving that during the time of the latter its real origin was known, at the same time its supposed origin was not disbelieved.

Sárngadhara-samgraha—a compilation by Sárngadhara: its peculiarity is that it is based upon the A'yurvedas (Charaka, etc.) on the one hand and the Tantric chemical treatises on the other. In the chapter on the purification and incineration of metals, 7 of these are recognised, but strange to say there does not occur any mention of zinc. Later on, 9 metals are named including two alloys, brass and bell-metal, after the 9 planets, the significance of which will be discussed in the proper place.

The date of Sárngadhara can be ascertained with accuracy, as besides this medical compendium he is the author of the Paddhati, a voluminous miscellaney, containing, with other matters, a poetical anthology. The author dates his work in samuat 1420 or A. D. 1363. The name of the author's father is Dámodara and that of the grandfather Rághavadeva. The latter was highly considered by Rájá Hammíra, the Chauhan.\*

After the sack of Chitor by Alla-ud-din in A. D. 1303,
 Mewar was occupied by the garrisons of Delhi. Hammira

There is a big commentary on this work by A'dhamalla, whose ancestors settled in the city founded by Hammíra.\*

Rasendrasárasamgraha: The author, Gopálakrishna, begins by admitting that his treatise is a mere compilation based upon many Tantras, though he mentions by name only two, namely, Rasamañjari and Chandriká. Special stress is laid on the therapeu-

recovered his ancestral throne and during his prosperous rule of sixty-four years (I301-1365) and that of his successors arts and literature found liberal patrons (vide Tod's "Annals of Rájastan"). The court of Hammira attracted another distinguished physician named Saugata Simha as we gather from the colophon to a noted recipé.

# एषा सीगतस्त्रं इनाकशिषना लोके प्रकामीकता इम्मीराय महीसुन्न \* संभोजभाने मृत्रम्।

\* A'dhamalla gives an account of his family. His Grandfuther was one Chakrapáni, not to be confounded with the celebrated medical author of Bengal (Vol. i, Intro. liv) and he himself was attached to the court of a ruler named, Jaitrasimha, whose capital Hástí kántapuri was situated on the river Charmanvatí. We reproduce in the next page the text which is somewhat corrupt from the copy preserved in the Library of the Sanskrit College, Benares.

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tic efficacy of mineral preparations. Like Rasendrachintámani it assigns a minor place to the ancient Ayurvedic method of treatment by kasháyayoga, i. e., by herbs and simples; as far as the knowledge of chemical processes goes, it must be held inferior to the former. Numerous medicinal recipés

श्रीवास्त्र व्यक्त प्रस्ति व्यक्त विश्वतः
श्रीवास्त्र विश्व विश्वतः
तद्वदे कि वहता प्रसिद्धश्रीचक्रपाचिः कुलके रवेषुः (न्दुः)
तस्य बुद्धसभगस्य तन्त्री भावसिंद इति सूपितनान्यः ।

तस्य बुद्धसभगस्य तन्त्री भावसिंद इति सूपितनान्यः ।

वस्यास्त्री दोर्चनित प्रदृष्टी नास्यादमङ्की
तिन विश्वति प्रदृष्टी नास्यादमङ्की
तिन विश्वति प्रदृष्टी नास्यादमङ्की
तिन विश्वति प्रदेश प्रस्तिता कामीव विद्यानीस्थाना यत्र सरासरिद्धवतरा चर्मास्त्रती पापदा ।

यस्यां प्रदृष्टिवपरयदचान्त्रतः स्थापितः
स्थानी प्रभावति प्रस्तेनतिषु श्रीजैनसिंदः प्रसुः ॥
तस्यां मार्जभरोक्तानां योगानां च प्रदायिना ॥

क्रियते सादमहेन संदिवायाः प्रदीपिका ॥

For a description of some of these vide "Journal des Savants," April, 1898.

agree word for word with those in Rasendrachintámani, which only proves that both have drawn on a common stock. There is no question of the one borrowing from the other, as internal evidence proves that both belong to the same period. Abhayananda Gupta in the preface to his edition says :- "There is a tradition to the effect that Gopála Kavibhúshana of Dakshina Vanga is the compiler of this book ; but this can scarcely be accepted as he lived not long ago." Again. "Its commentator, Rámasena Kavindramani (author of Arthabodhiká) was court physician to Nawab Jaffer Ali Khan of Bengal (Mir Jaffer) some 200 years ago." Rámasena himself quotes from 3 commentaries of this book; hence it was recognised as of some degree of importance at that time and must have been composed long before. This work is very popular in Bengal and is a vade mecum of the local Kavirájas.

Rasendrakalpadruma is another work of this period. It deals chiefly with mineral preparations and is a mere compilation from Rasárnava, Rasamangala, Ratnákara, Rasámrita and Rasaratnasamuchchaya; the numerous citations with which it is replete are
of some use in correcting many doubtful readings in these latter. Our MS. is incomplete,
the first few couplets and the sequel being
lost; for the opening lines of the work see
Aufrecht's Catalogue of the Bodleian Library,
MSS., pt. 1, p. 321.

Dháturatnamálá: This epitome is devoted exclusively to short processes of killing metals and minerals. Six metals are recognised at the outset, namely, gold, silver, copper, lead, tin and iron as in the ancient works; but strange to say later on kharpara, which is the mineral calamine, is taken as synony. mous with jasada or zinc. We have before us a MS. procured from Benares. It is full of corrupt readings. The copy noticed in the Bodleian Library Catalogue seems to be more correct. From the colophon in the latter we learn that the author is one Devadatta of Gujaráta, but in the Benares exemplar

Vol. i. p. 158.

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this portion has been coolly tampered with, so that this poor compilation may be palmed off as an integral part of a Samhitá of the Asviníkumáras, the divine physicians, and thus entitled to the respect due to revelation. This work cannot be placed earlier than in the 14th century. Here we have a serious sidelight into the history of literary forgeries.



## CHAPTER IV.

### MODERN PERIOD.

1500-1600 A. D.

We have now arrived at what may be termed the modern period in Hindu chemistry and materia medica. The characteristic of this period is that over and above opium, we have some other foreign drugs incorporated into the materia medica. By the beginning of the 16th century A. D. the Portuguese had fairly established themselves at Goa and some other parts of India,\* and as a result of intercourse with them, that dreadful scourge—the venereal disease—had made its appearance. Sanskrit medical treatises from the Charaka and Susruta downwards and ending with Sárngadhara are silent about this malady though they give fairly

<sup>•</sup> The political influence of the Portuguese as early as 1533
A. D. is evident from the fact that Sultan Bahadur, king of Gujaráta, entered into a treaty with them and through their assistance raised a force of 6,000 Abyssinians—"Memoirs of Humayun".

accurate descriptions of diseases of the genital organs (ਤਪਟੰਸ). But syphilis had now to be reckoned with and a new name had tobe coined for it. Accordingly we find Rasapradipa, one of the standard works of this period given to Tantric method of treatment, prescribing calomel and chobchini (China root, Smilax China, Linn) for what is now termed for the first time Phirangaroga or the disease of the Portuguese. According to Flückiger and Hanbury "the use of this drug as a remedy for syphilis was made known to the Portuguese at Goa by Chinese traders about A. D. 1535." Thus from an independent source we can arrive at the approximate date of Rasapradipa. This work also gives us a detailed process for the preparation of mineral acids by distillation which is here termed samkhadrávaka (lit. a solvent for conch shells) and is described as "endowed with the property of dissolving metals." It is thus evident that the use of mineral acids as a solvent for metals was unknown in India before this time.\* A very

<sup>\*</sup> Vide Note on mineral acids, vol. i. p. 185.

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noteworthy circumstance in connection with this is that the Bhávaprakása, which is posterior to Rasapradípa, is silent about samkhadrávaka, which had come to be prescribed by this time as a favorite remedy for indigestion and derangement of liver and spleen; the solvents being borax, treacle, etc.—(cf. vol. i, p. 130). In the Bhávaprakása among the acids we have only the juices of acid fruits. This is only another instance of the danger one is liable to incur by drawing inferences from argumentum ex silentiio.

Rasakaumudí is another compilation belonging to this period and as far as its contents go it is comparable to Rasapradípa in many respects; both opium and mineral acids are prescribed. From the colophon in the Calcutta Sanskrit College Library MS. we gather that the author is a physician named Mádhava. Curiously enough he is often confounded with the celebrated Mádhavakara, the author of the Nidánasamgraha, who preceded the former by some 8 or 9 hundred years.

The next work which should now claim our attention is the well known Bhavaprakása of Bhávamisra. It is a voluminous compilation in which the Ayurvedic method of treatment has been mainly adopted and as such ample citations are given from the Charaka, Susruta, Vňgbhata, Háríta, Vrinda and Chakrapáni. But the Tantric remedies could not altogether be given a wide berth and accordingly one or two chapters have been devoted to mineral preparations; but these have been borrowed chiefly from Rasapradípa, Rasendrachintámani, Sárngadhara and other standard works. Bhávamisra has been scrupulously candid in his acknowledgments to the various authorities quoted by him. Phirangaroga is mentioned as also its treatment with the help of calomel and chobchini. The author lived about the time of the Emperor Akbar and evidently in that part of India which is now known as the United Provinces and it is not to be wondered at that Mussulman influence is discernible in his book.

We conclude our survey of this period

with the notice of a remarkable production entitled Dhátukriyá or "operations with metals"; it is in the shape of a dialogue between Siva and párvatí; in short, it pretends to be a part and parcel of the Rudrayámala Tantra. The work cannot be placed earlier than in the 16th century A.D., as it contains reference to the country of the Phirangas and to Rúma, the Arabic name for Constantinople. For the first time we come across the very appropriate term dáhajala (lit. burning water) coined to denote sulphuric acid. The information about the metals is of very meagre and poor description and it has been needlessly spun into an inordinate length. The author evidently cosiders it a pious fraud to make such statements as follow emanate from the mouth of Siva himself :-

"By using coins made of imitation gold one can carry on exchange . . . and thus enrich oneself."

<sup>\*</sup> We hav in haud transcripts of two MSS.—one from the Library of the Mahárájá of Ulwar, the other named somewhat differently, Dhátumaújarí, from Benarcs. They agree very closely.

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The curious reader who is referred to the translations of the selected portions of the text given elsewhere will not fail to recollect similar passages in the Leyden Parchment where the dishonest goldsmith gives numerous recipes for "augmenting gold." \* Fraudulent attempts in the direction of palming off alloys of base metals, possessing bright, yellow lustre, for gold, have been made in all ages and in all climes (cf. extracts from Rasárnava, Vol. i, p. 74).

Arkaprakása or a treatise on the preparation of medicinal tinctures and essences should also find a place here; † its authorship is ascribed to Rávana, the mythical king of Ceylon. The contents of the work, however, reveal its date. For instance, mercury, treated with S'amkhadrávaka, is prescribed as the remedy for "Phirangaroga" (syphilis).

Berthelot: "Collection des Alchimistes grecs" ( trad.
 p. 287). "La Chimie au Moyen Age," T. I. p. 31.

<sup>†</sup> There is a Calcutta edition published by Ganesa Chandra Ghosha; we have compared it with a MS. procured from the Sanskrit College, Benares. They agree remarkably well.

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Opium also is prescribed; while the term yasada is used to indicate zinc. As a distilling apparatus a tinned copper vessel is recommended. Mahommedan influence is distinctly discernible in this hybrid production. The very title of the book is no doubt Sanskritised from the Persian arrak (essence).

It is unnecessary to proceed further. We have before us the MSS. of Rasamanjari by Sálinátha, of Rasaranjana, of Gandhaka-kalpa (a Tantra), of Rasárnava (quite distinct from the standard work bearing the same title), of Rasaratnákara (altogether different from that of Nityanátha) and several others. As all of these repeat ad nauseam the processes already described, we refrain from examining their contents here.

#### CHAPTER V.

# INDIGENOUS ORIGIN OF INDIAN ALCHEMY.

The reader who has been able to follow us throughout with patience will not have been slow to recognise that alchemy in India has been developed all along on independent lines. Its origin and growth are interwoven with a phase of religious activity—the outcome of purely indigenous traits—which has been discussed at length in chapter i.

The only instance in which we find some allusion to adepts outside the pale of Hindu institutions occurs in Rasaratnasamuch-chaya.\* But the term Mlechchha used there is a generic one applied indiscriminately to

<sup>\*</sup> बेक्क साध्यान्. Vide Vol. i, Sans. texts, p. 56; a variant in the Pooms edition has नेत्र साध्यान कान्, which must be rejected as both the Benares and Kasmir MSS. accept the former.

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the Sakas, the Yavanas (Greeks or Bactrians), the Chinas (Chinese), etc. The Hindus have never been shy of acknowledging their obligations to the Yavanas; Varáhamihira for instance expresses his admiration for the proficiency of the latter in the field of astronomy and would gladly learn at their feet.\* In the Mahábhárata again we find the services of the Yavana architect, Purochana, requisitioned. We have not, however, come across a single passage, which may be construed into implying a hint to alchemists in the West. That the term Mlechchha in R.R.S. really refers to the Kirátas is evident from the colophon to Rasahrídaya. †

Those scholars who have hitherto maintained that Indian alchemy is of exotic origin, have, we are afraid, done so on a priori

क्षेत्रका कि यवनाक्षेषु सम्बद्ध प्राध्वित स्थितं । ऋषिवनेऽपि पूज्यको किं पुनर्देवविक्तिः ॥

<sup>†</sup> Sans. texts, p. 39; there the four castes (ৰন্ধুৰ্য) are distinctly mentioned and the kirátas evidently included under the Micchebbas.

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grounds. Indeed the frame of mind which they have brought to bear upon this subject is not calculated to lead to a judicial and dispassionate verdict. The fact that the Hindus are indebted to the Greeks for substantial improvements in their astronomy is too often urged whenever it is necessary to support such a view.\* There is, however, very little affinity in the mode of growth of alchemy in India and of its congener in the West. The progress of magic, witchcraft and alchemy can be traced from the Atharva-

<sup>\*</sup> Cf.—"It was, however, Greek influence that first infused a real life into Indian astronomy. This occupies a much more important position in relation to it than has hitherto been supposed; and the fact that this is so, so ipso implies that Greek influence affected other brances of literature as well, even though we may be unable at present directly to trace it elsewhere." Weber: Hist. Indian, Lit. ed. 1892, p. 251. In justice to Weber, however, we should quote here his views on the independent origin of Hindu medicine; namely, "the weights and measures to be used by the physician are expressly enjoined to be either those employed in Magadha or those current in Kalinga; whence we may fairly presume that it was in those eastern provinces, which pever some into close contact with the Greeks, that medicine received its special cultivation."—p. 269.

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vedas onwards to the later Tantras according to the laws of evolution without any breach of continuity.

One of the most favourite doctrines of the neo-Platonists was that the metals were engendered in the womb of the earth under the influence of the planets. According to Olympiodorus (5th century A. D.) lead is begotten by Saturn, "electrum"\* by Jupiter, iron by Mars, copper by Venus, tin by Hermes, gold by the Sun and silver by the Moon. † Now, such a fascinating astrological belief was pre-eminently calculated to appeal to the Hindu instinct, especially as there was a "commercial and lively intellectual intercourse," to quote Weber's own words, between Alexandria and the West Coast of India. Varáhamihira's Vrihatsam-

An alloy of gold and silver was known by this name.
 Later on it disappeared from the list of metals, tin being assigned to Jupiter, and mercury to Hermes.

<sup>†</sup> The influence of the astral bodies on the production of the metals can be traced to Proclus' commentary on the Timaus.—Berthelot: "Les origines de l'Alchimie:" p. 49; also Coll, des. Alch. Grecs, trad. p. 100.

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hitá, if anything, is a repertory of astrological notions. In vain do we look even there for any such chance and solitary reference.\* The alchemical literature of India is equally silent about it. † True it is there are two metals which are often designated as the sun and the moon respectively, namely copper

<sup>\*</sup> Chapter xvi of this work treats of "countries, people and things belonging to the domain of each planet." Among sundry other things "the Sun is the lord of gold and fire." Thousand and one articles are said to be presided over by the Moon, Mars, Mercury, Jupiter, Saturn, Venus, Ráhu and Ketn; but nowhere is there any connection between the planets and the metals. Vide Kern's trans., pp. 97—101.

<sup>+</sup> The mythical origin of some metals is given in the Purámas; but no reference to the astral bodies is to be found.
Thus silver originated from the tears of the God Siva, copper
from the semen of the God Kártikeya, lead from the semen
of the Snake God Vásuki, iron from the different parts of the
body of the demons called Lomilas; and gold from the
semen of the God of fire. Some vague and remote connection only can be established between this sort of nomenclature and that of the old Greco-Egyptian alchemists.
According to the latter mercury is sometimes dasignated as
the semen of Hermes; whilst in the Tantras it is the semen
of Siva ( प्राचित्र ). Vide "Intro. a l'élude de la chimie des
anciens," p. 11.

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and silver. But this has nothing to do with the planetary generation of these metals. In the imagery of the Sanskrit poet the crimson tint of the rising sun and the pale white lustre of the moon are comparable to the colour of copper and silver respectively.

The old Greek writers repeatedly refer to the mystic relationship between the seven planets and the seven metals. In the Sanskrit literature, however, beginning with the Susruta and coming onwards to Rasaratnasamuchchaya, we invariably find six metals recognised, alloys being rigorously excluded from the list and regarded simply as "artificially made-" † It is only in the Sarngadhara and other later works that we find seven metals enumerated; ‡ but this author

सर्थतारारतासाचि नागवको च तीव्यकम् । घातवः सत्र विदेशाः

<sup>\*</sup> रॉब, क्के and other synonyms are as a rule applied to copper but rarely to gold.

<sup>+</sup> Vide Vol. i, pp. 48, 72 and 127.

<sup>‡ (</sup> चार ) brass being taken as the aditional metal; sinc was evidently unknown to Sárngadhara.

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is guilty of a curious inconsistency, since in a subsequent part of his book he adds two more to the list and quietly lays down that there are nine metals, which derive their names from the nine planets. This may be read as a sort of vague and indistinct connection between the metals and the astral bodies.

The Arabs who adepted many of the Greek doctrines of alchemy also represented the seven metals by the seven planets. In fact it was through the medium of the Arabs

Sáringadhara stops here, but his prolix commentator, A'dhamaila supplies the deficiency by making copper stand for the Sun, silver for the Moon, brass for the Mars, iron for Saturn, gold for Jupiter, tin for Venus, lead for Mercury and bell-metal and varialoha for Rahu and Ketu respectively.

It will also be noticed that lead is here represented by Mertury; but in the Hindu alchemy mercury always stands as the visible manifestation of the God Siva, it being generated from his semen, hence the name दशीन given to it.

<sup>&</sup>quot;Kámsya" (bell-metal) and "Vrittaloha" or "Vartaloha" (cf.—Vol. i. p. 114) make up the number. Ráhn and Ketu are the two mythical planets; they are in reality the ascending and descending nodes in the scliptic. Ráhu is supposed to cause the eclipse of the sun and the moon by swallowing it up.

and the Jews that a knowledge of the Greek sciences including alchemy filtered to the European nations during the middle ages.\*
We have already seen that Rájputána had been overrun and even occupied for a brief period by the Mussulman conquerors shortly before the time of Sárágadhara and it is reasonable to suppose that he had gleaned some astrological notions from that quarter.

We now advert for a moment to the main question of the comparatively modern and scientific phase of Hindu astronomy with the science of Alexandria. Although it is admitted by all those who are entitled to speak with authority on the subject that the Hindus borrowed from the Greeks and thus improved upon their older system, many points have yet to be cleared up. Professor Whitney who has

<sup>\* &</sup>quot;C'est par l'intermédiaire des écrits arabes et hébreux que la plupart des connaissances scientifiques des Grecs «n mathèmatiques, en astronomie, en physique et en médecine, ont été transmises au moyen âge occidental; les écrits Grecs proprement dits n'ayant guère été connus directement avant la Renaissance,"—"La chimie au Moyen Âge," T. i. p. 229.

carefully studied the subject is struck with the circumstance that the Súryya and other Siddhántas bear resemblance to the system of Hipparchus rather than that in the Syntaxis.\* In other words the transmittance of astronomical knowledge must have taken place before the time of Ptolemy. Now the period of lively intercourse is precisely that covered by the age of Ptolemy and that of his followers, and yet the Indian astronomers seem to be unaware of his teachings.†

Intro. to "Suryyasiddhanta". We find from Ptolemy that the observations of Hipparchus extended from B. C. 162 to B. C. 127. Ptolemy flourished at Alexandria in the second century A. D., under the reigns of Adrian and Marcus Aurelius.

This was also pointed out long ago by Colebrooke, c. g. "The whole cluster of astronomers mentioned by Brahma Gupta must be placed in the interval between the age of Hipparchus, and possibly that of Ptolemy."—Essays, pp. 411—412.

<sup>†</sup> A'ryabhatta composed his treatise "Laghváryabhattíyam," in 496 A. D., and Varáhamihira his "Pańchaeiddhántiká" about 550 A. D. But these astronomers borrowed from the much older treatise entitled "Romakaeiddhánta" ascribed to Srísens, and Paulisasiddhánta (vice Thibaut' Intro. to Pańchaeidhántiká, xxvii—xxxvi).

This mystery has never been clucidated; Dr. Thibaut's arguments are ingenious, but, we are afraid, by no means convincing.\* Indeed in the purely mathematical sciences the Hindus far excelled the Greeks of the Alexandrian school. A'ryabhatta's knowledge of algebra was superior to that of Diophantus and as for arithmetic it is generally acknowledged to be of Indian origin.†

The last word on the subject has yet to be said and it is doubtful if this dark recess will ever be illumined. In the meantime it would be better to hold our judgment in abeyance. At best we can only launch into hypotheses

<sup>\*</sup> L. c., pp. li and liii.

<sup>†</sup> Cf.—Colebrooke: "Admitting the Hindu and Alexandrian authors to be nearly equally ancient, it must be conceded in favour of the Indian algebraist, that he was more advanced in the same."—Essays, ii, 429. Again, "in the whole science he [Diophantus] is very far behind the Hindu writers," ibid., p. 438.

Kaye has recently questioned the priority of the claims of the Hindus 1 Vide J. A. S. B. iii [N. S.], July, 1907.

# or indulge in dogmatic assertions.

\* One who approaches this subject should divest himself of prepossessions or the "bias of patriotism" as Herbert Spencer puts it. A very agreeable feature in this controversy is that those who are most competent to speak with authority are extremely modest, nay diffident in giving expression to their views. Weepcke in his masterly memoir "on the propagation of the Indian numeral symbole" says:—"La solution parfaite de ces problèms ne résulterait que d'une connaissance tellement complète des événements et de leurs phases, qu'il faut à peu près renoncer à jamais l'obtenir. D'un autre côte, remplir les vides par des hypothèses arbitraires au preconcues serait livrer l'histoire des sciences eux hasards et au dogmatisme des inspirations individuelles." "Journal Asiatique" (1863).

Lassen whose modesty is only equalled by his profound scholarship observes:—Es ware sehr wanschenswerth, daßs ein mit der gehörigen kenntnifs der Sanskritsprache ausgerüsteter Kenner der Mathematik und Astronomie es unternähme, aus diesen vorhandenen Hülfsmitteln die Lücken unserer Kenntnifs auf diesem Gebiet des Indischen Alterthums auszufüllen; für jetzt müßen wir uns darauf beschränken, die hauptsächlichsten Ergebnifse der bisherigen Untersuchungen zusammenzustellen." "Indische Alterthumskunde." Vol. ii. p. 1150; ed. 1874.

#### CHAPTER VI.

# SOME NOTED INDIAN ALCHEMISTS AND THEIR WORKS.

Aufrecht in his notice of the MS, of Rasaratnasamuchchaya, \* evidently from a mistaken notion that the pursuit of chemistry was unknown in ancient India, goes somewhat out of his way in asserting that the names of the 27 alchemists, mentioned in the beginning of that work,† are mostly apocryphal. We have, however, positive proofs that these personages far from being evolved out of the imagination of the author existed in real flesh and blood and contributed not a little to the progress of chemical science. Thus we read in Rasaratnákara of "chemical operations performed by Mandavya" and also find Ratnaghosha taking part in a dialogue on certain processes, ‡ Yasodhara, again, is the author of the comprehensive work named Rasaprakásasudhákara

<sup>\*</sup> Catalogus Catalogorum, ii. p. 116.

<sup>†</sup> Vide Vol. i, p. 77.

<sup>‡</sup> Eng- trans. pp. 6-8.

which we have noticed at some length in the present volume. Vyádi is a prominent name both as a grammarian as well as a chemist. The Garudapurána quotes him as an authority on gems.\* Nandí, as we have already seen, is distinctly referred to by Somadeva as the inventor of the koshthí apparatus and of the process of sublimation. †

There are, indeed, a great many names scattered throughout the mass of chemical and medical literature, some of which have been handed down to posterity, sometimes on account of the important processes they invented and sometimes, again, because of the efficacy of the metallic preparations which they introduced. Thus in Rasendrachintámani we come across the name of Siddha Lakshmísvara. The names of the sage Brahmajyoti, Manthánabhairava, Svachchhandahhairava and Gahanánandanátha have in this manner been rescued from oblivion. Most of these were Buddhist monks.

<sup>\*</sup> व्याक्तिगाद जगतां कि सद्दाप्रभावः सिद्धी विदय्यक्तितृत्वस्या दयानुः । Intro., lv.

Sivadása in his commentary on Chakrapáni quotes besides Patañjali, Bhavyadattadeva as an expert on iron preparations. We give below the names of some of the authors and their works over and above those already noticed. It is scarcely possible to submit an exhaustive list.

Name of the Author.

Name of the work.

Anandanubhava Balabhadra Bhojadeva Chandrasena Charpata Dhanapati Garudadattasiddha Gorakshanātha (Unknown) (Unknown) Harihara Kańkālī Kapālī Kesavadeva Mallāri Narahari Rāmarāja (Siddha) Bhāskara (Siddha) Pränanätha Srīnātha Trimallabhatta Vaidyarāja

Vandimisra Väsudeva

Rasadīpikā. (Unknown). Basarājamrigānka. Rasachandrodaya Charpatasiddhanta. Divyarasendrasāra. Rasaratnavali. Gorakshasamhitä. Bauddhasarvasva. Rasesvarasiddhänta. Rasavisvadarpana. Rasakańkāli Rasarājamahodadhi. Yogaratnākara. Rasakautuka. Rasayogamuktāvalī. Rasaratnapradīpa. Rasendrabhäskara. Rasadīpa. Rasaratna. Rasadarpana. Rasakashāyavaidyaka. Yogasudhānidhi Rasasarvesvara.

# The Cantric Period

(Continued).

# Chemistry in Rasaratnakara of Nagarjuna.

[In the rendering of Rasaratnākara of Nāgārjuna and other Sanskrit texts we have often given only free translations. Such passages as are unnecessary repetitions or are not of sufficient interest to the general student of the history of Chemistry have been left out, ]

#### CHAPTER 1.

I shall now speak of the purification of the important rasas (minerals).

What wonder is it that rajavarta digested with the juice of Acacia sirisa converts silver of the weight of one gunja into one hundred times its weight of gold of the lustre of the rising sun? 1

Regarding rasss see Vol. 1, p. 79.

What wonder is it that yellow sulphur, purified with the juice of Butea frondosa, converts silver into gold when roasted thrice over the fire of cowdung cakes ? 2

What wonder is it that calamine.....roasted thrice with copper converts the latter into gold ?\* 3

These laconic recipes all refer to the floating mass of traditions current at the time of the author on the transmutation of the base metals into gold. As they are of a fragmentary and disjointed character, the meaning is not always clear. Recipe 3 also occurs in Rashrawa; vide Vol. i, pp. 70-71. Various ingenious methods were resorted to for debasing gold or making an alloy, which would mimic the appearance of this metal. Silver, copper, lead, zinc and mercury were often made into an amalgam, and the latter rendered compact and coloured yellow with the aid of orpiment. No wonder that the law-books prescribe several penalties on the fraudulent debasers of the precious metals. Thus according to Manu "the king shall cause a gold-smith, who behaves dishonestly, the most nocuous of all the thorns, to be cut to pieces with razors." IX, 292,

The reader who feels interest in this subject may consult Berthelot's "La Chimie au moyen age," t. 1. pp. 31 et seq., where will be found several recipes for augmenting gold aurum plurimum facere, or for the "fabrication of gold." One example may be cited here. "Take gold, copper and mercury, make an amalgam of the whole, afterwards add sulphur, orpiment, "sandarac" (a kind of resin) and the bile of the vulture &c." The author of the recipe thus concludes:—"Thou wilt now discover a secret, which is sacred and worthy of praise" (1, c. p. 35).

What wonder is it that cinnabar digested several times with the milk of the ewe and the acids imparts to silver the lustre of gold glowing as saffron ? 4

Digestion [of minerals] is to be effected in the decection of Dolichos uniflorus, Paspalum scrobiculatum, the urine of man and the acid juices of [the fruit of] ratan (Calamus rotang) and afterwards with the addition of the alkalies (soda, borax &c.) The operation of roasting is to be performed thrice.—Cf. the process of Rasaratnasamuchchaya (R. R. S.), Bk. ii, 67-68 in Vol. i, p. 83.

What wonder is it that the pyrites macerated in the juice of Musa sapientum and in castor oil and clarified butter, and placed inside the bulb of Arum campusulatum and roasted [in a closed crucible] undergoes perfect purification? † 6

Chapala and other minerals, being macerated in the juice of the lemon for 3 days, become purified. Gold being smeared with the 5 earths, the ashes and salts ‡ and roasted, undergoes purification. 12.

Vegetable acids are meant here. Vide Vol. i, p. 128.

<sup>†</sup> Here extraction of copper from the pyrites is no doubt meant.

Cf. R. R. S. Bk. ii, 89-90; vide Vol. i, p. 84.

I Cf. R. R. S. Bk. z. 71, 85; vide Vol. i, pp. 128-129.

Silver alloyed with lead and fused with ashes becomes purified.\* 13

Lo it is not to be wondered at that copper, melted with the alkali derived from the earth† and the milk of the ewe, clarified butter and one-sixteenth of its weight of oil, will become pure like the crescent of the moon. 14.

Verses 23-25: Extraction of the essence of vaikranta: exactly the same as in R. R. S. Bk. ii, 71-72. *Vide* Vol. i, pp. 83-84.

Verses 25-30: Have reference to the extraction of copper from mākshika and tāpya (varieties of the pyrites). They agree in all essentials with Rasārnava, Ch. VII, 12-13. *Vide* Vol. i. p. 70

Verses 31-32: Extraction of zinc from calamine. Cf. R. R. S. Bk. ii, 163-164. Vide Vol. i, p. 88.

Verses 35-36: Exactly the same as in R. R. S. Bk. ii, 103-104. Vide Vol. i. p. 85.

Verse 37: Essence of darada, i. e. extraction of mercury from cinnabar by distillation. Cf. R. R. S. Bk. i, 89-90. Vide Vol. i, p. 78.

Refers to cupellation. Cf. Rasárnava in Vol. i, p. 68, footnote (1).

<sup>†</sup> पृथिवीमवेन चारेच may refer to natron or to saltpetre.

Verses 50-51: Dissolution of gems (pearls &c.) by digestion in vegetable acids, e. g. sour gruel (impure vinegar) and the juice of certain acid plants.

Here ends Chapter Second of Rasaratnākara by Nāgārjuna on the *killing* of diamond and the metals, extraction of the essence of minerals and liquefaction of mica.

#### CHAPTER III.

I shall now explain [the process of] fixation of mercury. The king of rasas (mercury), rubbed with the juice of lime, sal-ammoniac, the acids, the alkalies, the 5 salts, Piper nigrum, P. longum, the dried root of ginger, the juice of Moringa pler., the tuber of Amorphophallus companulatus, can readily amalgamate itself with the 8 metals. 1

Prajūāpāramitā (perfection of wisdom) appeared before Nāgārjuna at midnight in a dream and revealed to him the ingredients of a recipe (consisting of steel, copper, mics, pyrites, &c.) 4

Mercury is to be rubbed with its equal weight of gold and then [the amalgam] further admixed with sulphur, borax &c. The mixture is then to be transferred to a crucible and its lid put on and then submitted to gentle roasting. By partaking of thiselixir (i.e. the sublimate) the devotee acquires a body not liable to decay, 30-32

I shall now describe the Garbha yantram. \*

Recipe for Kejjali or athiops mineral,† 84-86

Having made salutation to all the Buddhas, free from the taint of sins, I shall now deliver the Kakshaputa tantram ‡ for the benefit of suffering humanity.

[The most important part, from an historical point of view, is the dialogue between Nāgārjuna, King Sālivāhana and Ratnaghosha.]

Nāgārjuna, whose end (salvation) had been attained, benevolent towards all living creatures, blessed with all favours, residing on mount Srīsaila, before him stood Ratnaghosha with folded arms,

<sup>\*</sup> The same as in Rasarnava, Vide Vol. i, p. 66.

<sup>†</sup> The process is practically the same as in Chakrapáni; vide Vol. i. p. 58.

I There is extant a Tantra, which goes by this name, the reputed author of which is Nagarjuna.

saying: "Be pleased to communicate to me knowledge on chemical operations."

Nāgārjuna said :-

Well done! well done! I am pleased with your devotion and shall convey to you all that you want to know, namely remedies for warding off wrinkles, grey hair and other signs of old age. Mineral preparations act with equal efficacy on the metals as on the body (human system). \*

For the benefit of living beings I went through all manner of penances for 12 tedious years and worshipped the goddess Yakshini presiding over the Ficus religiosus. Then I heard an oracle.

Nāgārjuna said :-

O Goddess ! if thou art propitiated, be pleased to communicate to me the rare knowledge of the' fixation of mercury.

Sālivāhana said :-

I have dedicated to thee, O Goddess! treasures of gold and gems, now I await thy instructions.

This was a favourite metaphor with the alchemists. Cf.
 Vol. i, Intro. lxxvi.

The Goddess said :-

Well done! well done! O wise ruler! I shall speak to you of chemical operations performed by Māndavya.\* ... A disciple should be intelligent, devoted to work, sinless, and master of his passions. †

The apparatus known as koshthi, mouth blowpipe, cow-dung, substantial wood (as fuel), a pair of bellows, iron plates, \* \* \* having collected all these, chemical operations are to be performed.‡

Ratnaghosha said :-

Having prepared with great care "the powder of projection," which transforms a ten million times its weight of the base metal into gold, § • • •

Nāgārjuna said :-

I shall convey to you what has been experimented upon by Sākānda. ¶

A well-known alchemist; one of the 27 adepts mentioned in the opening lines of R. R. S. Vide Vol. i, p. 77.

<sup>†</sup> Cf. "Initiation into discipleship" in Vel. i, p. 115.

<sup>‡</sup> Cf. Rasàrnava in Vol. i, pp. 64-65.

<sup>§</sup> कोटिवेधी सद्वारस:—the term वैध: has technical meaning. Cf. Vol. i, p. 120.

<sup>¶</sup> We are unfamiliar with this name, probably the reading is corrupt.

Tests for killed mercury.

The first two couplets are almost the same as in Rasarwava. Cf. Vol. i, p. 74.

When the quicksilver, which has acquired the colour and the lustre of the rising sun, stands the test of fire (i. e. is not readily volatilised), then it is to be regarded as fixed.

Here follows a list of apparatus borrowed from Rasendramangala—Detailed account of most of these will be found in R. R. S. Bk. ix. Vide Vol. i, p. 67.

### Chemistry in Rasahridaya of Bhikshu Govinda.

Quicksilver digested with sour gruel and then subjected to distillation is freed from [the impurities of] lead and tin. 1

Much the same as above. 2 \* \* \*

Description of the apparatus for purification of mercury by sublimation and distillation: it agrees almost literally with that given in R. R. S. Bk. ix, 6.8. Vide Vol. i, p. 121.

#### Patala vii.

Ingredients for making a vida for killing metals, Cf. Rasārnava, IX, 2-3. Vide Vol. i, p. 72.

Preparation of mild alkali from the ashes o plants :-

The process must be considered as a poor one compared to the elaborate description in Susruta Cf. Vol. i, p. 32.

#### Patala viii.

Alum, blue vitriol:-all these severally or collectively are favourable for imparting colour to quicksilver.

Experts [on the properties] of metals are of opinion that tin gives strength, tikshaa colour, lead unctuousness, copper all these qualities [to mercury.]

Couplets (in p. 29, Sans. texts): The purport seems to be that when mercury is rubbed with certain sulphides, e. g. orpiment, pyrites &c., and sub-

<sup>•</sup> The text is not very intelligible. The other ingredients mentioned are tikshan and kants, these being varieties of iron; but iron will not amalgamate with mercury. Tikshan may also mean a kind of saline earth. The old alchemists racked their brains in devising ingenious processes for robbing mercury of its fluidity and imparting to it various colours. Cf. Rasarava, IX, 2-3, XI, 197-198. Vide Vol. i, p. 74 and also "The Hindu method of manufacturing calomel,"—Ibid. p. 250.

limed, it assumes the colour of lac or Coccinella insect (a poetical and figurative way of expression for red colour) in the shape of the red crystalline sulphide.

#### Patala ix.

Vaikrānta, kānta, sasyaka, mākshika, vimala, adri, darada, rasaka:—these are the 8 rasas\* and their essences are well suited for chemical operations,

Sulphur, gairika, kshiti, khechara (mica), aŭjana, kankushtha:—these are the uparasas. Cf. Vol. i, p. 89.

Gold and silver are the noble metals.

Copper, brass, tikshua and kanta (varieties of iron) are the essential or substantial metals; lead and tin emit feetid odours. Cf. Vol. i, p. 113, footnote (1).

The six salts are:—Sauvarchala, saindhava, chülika (sal-ammoniae), sämudra, romaka and vida. The alkalies are:—Sarjikākshāra, yavakshāra and borax. (Vide Vol. i, Index of subjects.)

#### Patala xi.

A cupel made of boneash (goat's) and lined internally with borax &c.

Cf. Vol. i, pp. 79-81.

Colophon giving an account of the author :-

Madanaraths, King of Kirāta, teacher of mercurial lore, in whom the Goddess of the science of mercury and minerals (Chemistry), the source of all good, has taken her abode for the benefit of mankind, who can restore to the disfigured patient, afflicted with leprosy, the healthy coincilness and lustre of youth:

Bhikshu Govinda, well versed in chemical operations and loaded with honours by the King of Kirāta, composed this tantra entitled "Rasahridaya."

This tantra is written by Govinda, the grandson of Mangalavishuu and son of Sumanovishuu:

May Tathagata pronounce his blessings.

## Chemistry in Kakachandesvarimata Tantra.

Patala i.

The first patala gives the origin (mythical) of the tantra.

Patala ii.

Kākachandesvari said :-

· Please, give a brief account of the

Chemistry of the metals, the killing of mercury and minerals and the fusion of the gems. 3 4

Sri Bhairava said :-

Mercury rubbed with the ingredients of the vida (see Vol. i, p. 72) and roasted in a closed crucible, is killed instantly. That mercury now sequires the power of converting a base metal into I,000 times its weight of gold. 13-16

Copper, treated with the above preparation of mercury and rubbed with the acids, alkalies and the milky juice of *Calotropis gig.*, and roasted in a crucible, turns into gold. 18-20

Earth for making crucibles, 21-22 Cf. Vol. i, pp. 67-68.

Transmutation of iron into gold :-- process not clear. 25-32

#### Patala iii.

Liquefaction of mica :-

Thin plates of mica are to be smeared with the 3 alkalies and borax and strongly heated in a crucible. The whole mass fuses.\* \* \* \* 29-30

Refractory silicates are treated similarly at the present day with the "fesion mixture."

## Chemistry in Rasendrachudamani of Somadeva

Sans. texts, p. 51.

Tests for killed iron (rouge).

As R. R. S. has borrowed these from the present work, it is unnecessary to repeat them here. Vide Vol. i, pp. 118-119.

Sans. texts, pp. 52-53.

Take lead of the weight of 30 palas and rub it with the milky juice of Calotropis gig. and calcine it till its weight is reduced to a karsha: this residue, even if it be calcined a thousand times, will not undergo further decay (i.e. diminution in weight). Metallurgists call this residue derived from lead Chapala.

Tin also similarly treated will yield a chapala, which, on merely being touched with the hand, kills (fixes) mercury. This mercury is recommended for metallurgical and not for chemical purposes.

Possibly it refers to lead derived from argentiferous galena. The lead, being cupelled off in the shape of litharge, will leave a button of silver, which will not undergo oxidation.

#### Saus. texts, pp. 58- 4.

[A somewhat complex process described, which is not very clear. We shall try to give the purport thereof. The quantitative measurements are of particular interest.]

I pala of tin should be taken and rubbed with 10 nishkas of mercury and made into a cake with the addition of zinc; it is then to be digested with the decoction of certain herbs and plants and warm vinegar and once more rubbed with 1 pala of blue vitriol † and the juice of Abrus precatoring. The mass is then to be divided into small pills; these should then be put into a crucible with the lid on and the fire to be urged by means of bellows. The essence is then to be taken out of the crucible. This essence of the weight of 10 Sanas is then to be enclosed in a mixture of ashes and salts and roasted. This essence of the weight of 2 nishkas is then to be fused with 80 times its weight of lead . . . This (essence) is also termed chapala, Cf. "the gold-like alloy" in Vol. i. Pp. 74 75.

<sup>\*</sup> रस्यास स्थेन.

<sup>†</sup> पशा**रंपर** सस्पेन.

#### Sans. texts, p. 55.

When quicksilver has been deprived of its physical properties (lustre, fluidity &c.) it is known as nashtapishta. Cf. Vol i, p. 74.

Somadeva will now give a brief account of the apparatuses, after having consulted numerous chemical tantras. (Here follows the description, which has been reproduced verbatim in R. R. S. Vide Vol. i, pp. 121 et seq.)

Urddhvapātana apparatus as described by Nandin. Cf. Vol. i, pp. 124-125.

Kosht&i apparatus as described by Nandin. Cf. Vol. i, p. 69.

# Chemistry in Rasaprakasasudhakara of Yasodhara.

Sans. texts, p. 57.

Preparation of karpūrarasa (lit. camphor of mercury, i. c. calomel): practically the same process as given in Vol. i, pp. 250-51.

[Note. Calomel is prescribed here only as an aphrodisiac and a specific for leprosy but not as a remedy for syphilis.]

#### Sans. texts, pp 59-61.

Rasaka (calamine): the author of R. R. S. has evidently borrowed his description of this mineral from the present work. Cf. Vol. i, p. 87.

Extraction of zinc from calamine :

(The process agrees almost word for word with what is given in R. R. S. The essence possessing the lustre of lead runs out of the crucible.\*)

### Sans. texts, pp. 61-62.

Saurāshtīī or tuvarī (alum-earth) almost identical with R. R. S. Cf. Vol. i, p. 91.

\* \* \* The essence extracted from the alums (i. e. oil of vitriol) is to be used for operations with metals and not as medicine.

# Sans. texts, pp. 62-65.

[ Descriptions of various kinds of pits for calcining and roasting purposes are given; as also their dimensions with the number of cowdungcakes to be used as fuel &c. Cf. the typical roasting pit in Vol. i, p. 127.]

Here ends Chapter X of Rasaprakāsasudhākara by Yasodhara, son of Padmanābha.

<sup>•</sup> In R. R. S. we have "the essence possessing the lustre of tin."

Sans. texts. pp. 65-66.

Hemakriā or process for the fabrication of gold: "I shall now speak of some curiosities of metals, partly from my own experience and partly from the classics on the subject. Calamine, cinnabar, copper pyrites and realgar are to be rubbed with the milky juice of Euphorbia neriifolia for 7 days together and then to be digested another 3 days. Melted copper or silver or lead, being alloyed with the aforesaid mixture, acquires the power of converting 100 times its weight of base metal into gold." Cf. ante, p. 2.

# Chemistry in Rasachintamani Of Madanantadeva.

Sans. texts, p. 68.

Svetabhasma: Cf. ante p. 16 and also Vol. i, pp. 250-51.

Sans. texts, pp. 69-70.

Two processes for the fabrication of gold :much the same as already quoted from Yasodhara.

Process for the fabrication of silver :-

Take 1 part of bell-metal, 2 parts of silver, 4 parts of steel (?) \* \* these to be fused with

<sup>ै</sup> सत्तेथी and सहस्रवेथी are technical terms ; for the meaning of वेथ vide Vol. i, p. 120.

tin and borax ;—by this process will be made silver which will pass current for commercial purposes.

Sanz. texts, p. 71.

Extraction of zinc from calamine :-

The process is much the same as given above (p. 17), whith this difference that, whereas Yasodhara hits off the completion of reduction when the flame issuing from the pot ceases to be blue, the present author directs that the pot is to be taken out of the furnace as soon as white fumes begin to appear. The crucible is then to be held in an inclined position so that the lead-like essence of calamine drops on the ground.

# Chemistry in Rasakalpa (Rudra yamala Tantra.)

Bowing to Siva, the lord of mercury, and also, the feet of Chandikā, I write this Rasakalpa, the depository of mercurial lore.

#### CHAPTER 1.

Tests for killed mereury :-

Killed mercury is that which is devoid of (metallic) lustre, not so ponderous, white, des-

<sup>\*</sup> The author previously refers to the red, black, white and even yellow ash (calx) of mercury; it is not clear why he should

troyer of metals, divested of fluidity and non-volatile when stirred over a fire. 40 Cf. tests in Rasārnava in Vol. i, p. 74; as also in Rasaratnākara, ante, p. 9.

Purified mercury should be preserved in the hollow of a tooth or gem or bamboo. 42

#### CHAPTER II.

Gold, silver, copper, tin, lead and iron—these are the 6 metals; vartaloha, &c., (Vol. i, p. 114) are simply alloys. 1

Honest readers | I beseech you with folded arms to favour my book with your merciful glance.

The mahārasas are 8 in number; e. g. mercury, cinnabar, sasyaka, rasaka, &c. ... ... the rasas are mica, green vitriol and rājāvarta, &c. ... ... sulphur, orpiment and realgar, &c. are the uparasas as regarded by learned teachers. Cf. Vol. i, pp. 79 and 89.

There are 4 kinds of sulphur: white, black, yellow and red. Cf. Vol. i, p. 90.

here restrict himself to the white variety only. Chloride or sulphide of mercury, when treated with a metal and heated, kills (i. c. parts with its chlorine or sulphur to) the latter and in that sense it is a destroyer of metals with a The saurāshtris (alums) are of various kinds; the kāsīsas (vitriols) are of 3 kinds,—namely, kāsīsa proper, pushpa kāsīsa and hīrakāsīsa.• Cf. Vol. i, p. 91.

Gairika is stated to be of 2 varieties,—the one of golden bue, the other red; Kańkushtha and other rasas are also described by certain teachers; but these, however, are not referred to here, as we are treading in the footsteps of sages of old.

Sans, texts, pp. 75-78

For the purification of mercury this process is recommended by Svachchhandabhairava and Govinda.

Chülikalavana (Sal-ammoniae), sulphur and the ash of ginger, &c., digested one hundred times with cow's urine,.....make a vida for killing gold. Cf. Vol. i, p. 72.

This process for killing [metals] was revealed by Siva and has been transmitted by successive schools of adepts.

<sup>\*</sup> Hirákasa is the name by which green vitriol is known throughout India; Royle supposes that this word is derived from the Persian hura green, and Sans. kásísa, (Antiq. Hindu Med.) There is no necessity for looking upon hirákasa as a hybrid term, seeing that it occurs in the present work in which Mahommedan influence is nowhere traceable.

<sup>†</sup> Evidently Charaka and Sugruts, who mention only a few commonly occurring minerals. Vide Vol. i, pp. 29 and 44.

Extraction of the essence of copper pyrites, Cf. Vol. i, pp. 70 and 84.

Extraction of zinc from calamine :-

The process is practically the same as given in R. R. S. Cf. Vol. i, pp. 87-88.

I have performed the [aforesaid] experiments with my own hands and have seen them with my own eyes. They are not recorded from mere hearsay or from the dictation of a teacher. These are being promulgated for the benefit of mankind.

# Chemistry in Rasarajalakshmi of Vishnudeva.

Sans, texts, pp. 79-82.

Give an account of the common rasas and uparasas. Cf. Vol. i, p. 79.

# Chemistry in Rasanakshatramalika of Mathanasimha, physician to the King of Malwa.

There are several prescriptions given in which mineral preparations play a conspicuous part. We have quoted only two; in the first, among other ingredients opium occurs; in the second, the Svachchhandabhairavarasa, probably named after the celebrated alchemist, we have the calces of tin, iron and mercury along with other drugs.

# Chemistry in Pasaratnakara of Nityanatha.

Sans. texts, pp. 84-86.

Test for killed mercury :-

When the substance, being heated over a fire of paddy husks, does not further decrease in weight, it should be considered as reduced to a calx.

Purified mercury should be stored in the hollow of a tooth or horn or bamboo.

Directions for making factitious cinnabar (Makaradhvaja), Cf. Vol. i, p. 132 (footnote).

### Chemistry in Dhaturatnamala.

In the beginning the author after salutation says: "I shall speak of silver, gold, copper, lead, tin and iron as also of calamine, mics, pearls, coral, orpiment, realgar, the pyrites, mercury and diamond,—in fact, the properties of all the metals and minerals and the mode of their incineration."

Killing of silver. Cf. Vol. i, p. 107.

### Chemistry in Rasapradipa.

Description for preparing mineral acids by distillation:—"Sankhadrāvarasa or liquid for dissolving conchshells,—practically the same as given under "mineral acids" in Vol. i, p. 186. The last line says: "Cowrie-shells and metals dropped into the liquid are at once dissolved."

Preparation of calomel and treatment of "phirangaroga" (syphilis) with its application. Cf. Vol. i, p. 252.

# Chemistry in Dhatukriya or Dhatumanjari (Eudrayamala tantra.)

Sans. texts, pp. 98 et seq.

Tin, iron and copper are to be classed among the superior metals.

In general a metal being alloyed with silver is improved in quality. Sattvaja metal (i.e. an alloy of tin and copper, vide below couplet 15) is of middle quality. 12-14

Synonyms of the different metals. 39-49

Synonyms of zine: Jāsatva, Yasadāyaka,• rūpyabhrātā (lit. brother to silver), charmaka, kharpara, rasaka, &c. 50-51

Yessada is the name commonly given to the metal extracted from calamine, Vide Vol. i, p. 156

Pittala is an alloy of copper and zinc. 63

Kāmsyaka is an alloy of tin and copper. 65

Zinc being amalgamated with mercury gives rise
to rasaka, 68

[N.B.—Rasaka and kharpara are the names generally applied to the mineral calamine (vide Vol. i, p. 158), but here they stand for the metal (zinc) or its amalgam.]

Lead being killed with the aid of gentle heat gives rise to minium (red lead), 69

Copper in combination with the "burning water" gives rise to tuttha (green vitriol).—Thus manifold operations are performed with the aid of mantras and apparatus: all these belong to the province of Chemistry. 70.71

Synonyms of haritala (orpiment): Orpiment is a consumer of mercury and also a clipper of its wings,\* 79

Synonyms of realgar, cinnabar, mica, &c. 81-89 Synonyms of pearls, coral, tortoise-shell, conch-

<sup>•</sup> The sulphide of arsenic on being rubbed with mercury and gently heated converts the latter itself into the sulphide. The mercury is thereby killed and fixed i.e. deprived of its volatility (clipped of its wings—the Hindu alchemist's favourite figure).

shell, tusk of elephants, the tail of the peacock.

Localities for different metals. 113-121 [The information is very commonplace.j

Localities for copper specified: Nepāl, Kāmarūpa (the eastern portion of Assam). Bangala, † the country of the Micchehhas, Rūma and the country of the Phirangas, &c. 143-145

Localities for zinc : Kāmboja, Rūma, Balkh, &c.

Metals in combination with mercury and sulphur become fit for administration as medicine. 153

Process of roasting a substance in a stout glassvessel using goat-and-cow-dung-cakes and husks of paddy grains as fuel. 9 10

One part of gold and four parts of zinc are to be melted together and the alloy roasted in a closed crucible . . . the process repeated with the addition of alkalies . . . gold of a reddish yellow colour will thus be generated. 11-17

<sup>\*</sup> All these have been placed under the category of (दोज) inferior dhatu. Though the term dhatu generally means a metal, it is often applied to a mineral; here, however, it covers a much wider field.

<sup>+</sup> This is the name given to Bengal in many Tantras.

A process for making factitious cinnabar by pouring mercury into its own weight of molten sulphur and then adding three-fourths its weight of orpiment . . . The mass to be rubbed in a mortar and subjected to sublimation. 23-30

By using the angmented gold as a means of exchange one can amass wealth. 52

Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth. 85-86

Pure gold is to be alloyed with one hundred times its weight of copper and this [imitation] gold will resemble native gold, S8

Lead and copper being alloyed together will give rise to gold. 97-98

Colophon: Here ends the Chapter on the extolling of gold in Rudra-yāmala.

<sup>\*</sup> Cf. footnote, p. 2.

## Chemistry in Suvarnatantra or Svarnatantra.

The origin of the tantra is explained in the opening lines. Parasurāma having given away his worldly possessions to Kasyapa is rendered destitute, and thus has to invoke the aid of the God Siva for his very maintenance.

Siva said: Listen! I shall now reveal to you the most wonderful mysteries of Svarnatantra, 1-10

A kind of oil is exuded from the bulbous root of a plant; all around it within a radius of ten cubits oily water is exuded and a venomous snake lives under it. If you want to test the properties of the bulb, you should thrust a needle into it, and the needle at once dissolves. Having procured this bulb, rub it with mercury in a mortar and add the oil and subject the mixture to heat in a crucible. The mercury is at once killed and acquires the property of converting one hundred thousand times its own weight of the base metal into gold. • I4-18

Pure orpiment is to be rubbed with this oil for 20 days, and the former is killed thereby and loses its volatility. The 8 metals in the molten state being treated with this prepared orpiment acquire

<sup>\*</sup> सचवेधी सवेत्.

the power of transmutation. When the above oil is thrown into molten copper, it is turned into gold of beautiful lustre. Tin and bell-metal similarly treated are turned into silver, and copper, iron, brass and silver into gold. 19-24-

Sankhadrāvaka (aqua regia, see ante p. 24) is spoken of as an universal solvent . . . . . This solvent with mercury is to be placed in a glazed crucible and subjected to heat; the mercury, thus killed, can convert the 8 metals into gold. By partaking of this mercury one becomes immortal; even his urine and faces can convert copper into gold. • 1-10

This sort of belief was prevalent also at the time of the composition of Rasarmava.

# Knowledge of Gems.

A few words on gems may not be considered beyond the scope of the present work especially as the subject has already drawn the attention of some European scholars. We shall, however, limit ourselves, as Ifar as possible, purely to the physical and chemical properties of the precious stones.

It has already been seen that among the 64 branches of arts and sciences recognised in the ancient 'Kāmasūtra' of Vātsyāyana occur the following:—(a) the testing [of the genuineness or otherwise] of gold and the gems; (b) knowledge of the colouring of gems, as also of mines and quarries,† Varāhamihira (d. 587 A. D.) in his "Vrihat Samhitā" also conveys much useful information on this subject, but as he in his turn refers

Garbe in his "Indischen Mineralien" (Leipzig, 1882) gives the text and the translation of Ch. xiii of Narahari's "Rájanighantu"; this work, however, is comparatively modern. Much useful information on the subject with bibliographical references will be found in Professor Yogesa Chandra Ráy's treatise in Bengali entitled "Ratnaparikshå,"

<sup>+</sup> Vide Vol. i, p. 191.

to experts who preceded him, \* it may safely be concluded that long before this time it received adequate attention.

The Garudapurāna under the heading of Ratnaparīkshā (examination of the gems) devotes several chapters to a detailed and fairly exhaustive description of the gems. This Purāna like so many of its class discusses on a variety of topics, mundane and spiritual; in short, it may be looked upon as a sort of multum in parvo.

From time immemorial the gems have been valued in India not only for purely decorative and ornamental purposes, but also as agents for warding off perils and the malignant influences of the planets and for securing luck and longevity. Hence it is that particular attention is paid to the testing of gems, as their virtue increases in proportion as they are faultless and flawless.

The typical characters which were most relied upon for differentiating one species of a gem from another were (1) the relative weight, (2) hardness, (3) lustre, transparency and colour, (4) fusibility, especially when heated in combination with the alkalies. It will be noticed that even the lapidaries

<sup>&</sup>quot; पूर्वाचार्थः समुद्दिष्टं

and the mineralogists of the present day have to depend largely upon these properties in the classification of the stones. We shall now proceed to say a few words under each of the above characters following in the main the authority of Garudapurāna.

1. RELATIVE WEIGHT. We have purposely used these terms as contradistinguished from "specific gravity": as the latter connotes peculiar associations. The principle of Archemedes being evidently unknown among the Hindus, the measurement of volume could only be roughly approximate. To cite some illustrations. A stone may be of the same species as, and equal in volume to, a padmarāga (oriental ruby), but will differ in weight from the latter.\*

Empirical and arbitrary scales of weight were adopted as standards. A ruby occupying the volume of a gunja (abrus precatorius) may be equal in weight to 10.7 and 3 gunjas respectively. A ruby of the volume of a srigālakola (a kind of jujube) should weigh 12, 8 and 7 gunjas respectively. Again, a ruby of the volume of an āmalakī (phyllanthus emblica) should weigh 30.20

<sup>&</sup>quot;तुष्यप्रभाषसाच तुष्यजातेथीं वा गुरुलेन भवेत्र तुष्यः।

and 16 mäshäs respectively.\* In each case the gem which is of greater weight is superior in quality and the value thereof is enhanced in proportion.†

In the case of precious metals, however, adulteration was detected by an ingenious device, which may be regarded as a near approach to the principle of Archemedes. Suppose it is intended to test the purity of a specimen of gold. All that one has to do is to draw a wire of this gold and another of the standard gold through the self-same orifice [of corundum]. As these wires are of equal

The standard of weight has always varied in different times in different parts of India. 10 gunjas weigh about 18 grains. The seeds often vary in size.

<sup>\*</sup> We give below the standard weights as current at the time of Varghamihira.

<sup>8</sup> White mustards ... = I tandula (a grain of paddy)

<sup>4</sup> Tandulas ... = 1 gunja (abrus precatorius)

<sup>5</sup> Gunjas ... = 1 Máshá

<sup>16</sup> Máshás ... = T Karsha or suvarna or tolaka

<sup>4</sup> Karshas ... = 1 pals

t Garuda lays special stress on the high specific gravity (=4.0) of a genuine ruby. सम्बं विकार्तिलयं. again गुरुत समीन! गुमसंगद:। While high specific gravity is indicative of the excellence of the gems in general, in the case of diamond it is just the reverse. द्वा स्वंद्यान! गौरवाधानकारणम्। वजी तन् वैपरीयोन सूर्य: परिचलते a It is not easy to account for this qualifying clause, seeing that diamond has a sp. gr. of 3.5.

diameters, equal lengths will have equal weights, provided the sample is pure.

2. HARDNESS. There are many stones which in external appearance resemble a ruby, the spurious substitute may easily be detected by its difference in softness (low degree of hardness), and low specific gravity: again in case of suspicion the gem is to be rubbed on a whetstone; if it simply gains in lustre but does not lose in weight (by abrasion), the specimen is to be regarded as genuine (test of a ruby). † Diamond and corundum alone will scratch ruby and sapphire. Skilful lapidaries often make imitation diamonds of zircon, ruby, cat's-eye, rock-crystal and glass; hence they are to be tested by calling in the aid of learned experts. All the gems occurring in this world as also the metals will be scratched by a diamond, but the latter will not be similarly affected by the former. 

पकिष्यदे समाज समाज को दशी ग्रँदा।
 भाकी: सूर्य मानसमें निद्देशस भवित्रहा । Sukranfti.

<sup>†</sup> This is true in a qualified sense only. After the diamond corundum is the hardest of all known minerals.

<sup>‡</sup> The ruby and the sapphire are only varieties of corundum. Varáha classes corundum as a species of ruby, the former being dotted over with black and white patches and feeble in lustre [i.e. the non-transparent or course kind]. It is scarcely necessary to

To the above tests Rijanighanta adds another, namely, when a diamond is struck with an iron hammer, it is not broken to pieces\*

point out that the very word "corundum" is derived from the Hindi barand, a corrupt form of the Sanskrit karacinda. The statement "corundum will scratch ruby and sapphire" is not strictly accurate. There are degrees of hardness among the different varieties of corundum, the blue sapphire standing first in this respect.

We give here the original texts of which we have given above almost a literal translation.

> "संद्रप्रसदी सद्ता लघुलं विज्ञाति विद्वां सन् साम्येजन्यम् ।" "पप्रचारति सन्देष्टे जिलायो परिचर्वसेत् । एका बोद्यन्त्रयोभावान् परिमाण न सुचिति । स प्रोयः स्वजातिका प्रेयायानो विज्ञातयः॥" "वश्रां स कुद्यन्ति स विसुन्धानोन केनवित् । न मन्दं सेखाने कर्ष्यं प्रदायन्त्रतेल्योः॥"

"The reading of the text is very corrupt. Garbe gives as many as 12 variants; that adopted by him seems to be on the whole reliable as also his rendering: "Wenn or mit anderen steinen oder eisernen Hammern geschlagen nicht zerspringt." On account of its brittleness a diamond will readily be shivered into splinters under the blow of a hammer. The following extract from Bauer and Spencer's "Precious stones" (pp. 129-180) may prove of interest.—

"The hardness of diamond has often been confused with its frangibility or brittleness. It has been supposed, especially in ancient and mediaeval times that hammer and anvil may be shattered but not the diamond which lies between. 3. Lustre, Transparency, colour and other optical properties. Difference in lustre (अवश्रद) is often regarded as a diagnostic feature of the gems. According to Varāha gems of superior qualities should possess cool (lit. waxy) lustre, be limpid and emit rich rays. Classification according to colour is often enjoined. For instance, a diamond may be perfectly colourless, or it may be yellow,

This statement was made by Pliny, the great naturalist of ancient days, who was killed in 79 A.D. at the first historic eruption of Vesuvius. He proceeded to say further that the fragmentation of a diamond may be effected by subjecting it to a preliminary immersion in the warm blood of a goat, but that even under these circumstances the hammer and anvil will also be broken | According to Albertus Magnus (1205-1280) the blood is more efficacious if the goat has previously drunk wine or eaten parsely.

"Such being the views then held respecting the unbreakable and indestructible character of the diamond, it is easy to understand why the Greek word adamas, signifying unconquerable, should have been applied to this stone, although its application to the diamond is singularly inapropriate and inaccurate when its extreme frangibility is considered. Many a doubtful atone has been submitted to the test of the hammer, with the telief that the blow would be resisted only if the stone were a genuine diamond. Probably many beautiful stones have been sacrificed to this old belief. As a matter of fact, diamond is easily fractured, a very moderate blow from a hammer sufficing for the purpose; its perfect cleavage places it among the most brittle of minerals."

black, red or copper-tinted. Stones which are translucent, opaque and of dull colour are inferior in quality. In the case of diamond special stress is laid on its displaying the colours of the rainbow [due to its high dispersive power]. Some gems have only one shade of colour (क्षाय) others again two (क्षिकाय)

The changes in colour which the ruby and the sapphire undergo under the influence of heat had evidently been carefully observed. This test is to be applied with extreme coution as in case the pro-

रतं पीतं सितं श्रेरीय (Varaha)चातासं (Garnda).

Yellow diamonds are unknown in India at the present day at any rate. "India can claim for its own all the finely coloured stones of blue, green and red, not however, yellow diamonds, which come mainly from South Africa," (Bauer and Spencer), Crystals of black diamond should not be confounded with the black corbonado.

+ Probably refers to dichroism. As has already been pointed out the red ruby and the blue sapphire are only varieties of corundum, which often occur in well-developed crystals belonging to the rhombohedral division of the hexagonal system. "The dichroism of the ruby affords a means whereby it may be distinguished with certainty from other red stones, such as spinel and the different varieties of garnet, which crystallise in the cubic system, and thus being singly refracting can show no dichroism." (Bauer and Spencer). "The dichroism of the sapphires of Siam is specially well marked."—Ibid.

per degree of temperature winning is exceeded, the stone may be materially injured.\*

- FUSIBILITY (LIQUEFACTION). It was wellknown that all the gems with the exception of diamond would undergo liquefaction when strongly heated with a mixture of the two alkaline carbonates [now familiar in the Laboratory as the "fusion mixture"]. The liquid principle of gems रवजाद्रति was a favourite remedy with the Hindu Iatro-Chemists (Cf. Vol. i, p 103). most of the precious stones belong to the corundum and the spinel group, they easily yield treatment with sodium and potassium carbonates. In the case of the pearls it is recommended that they should be enclosed inside lemons and placed in a mass of paddy grains [for the sake of the warmthl.
  - यावल चंक्रमेदधि पत्रराशीपश्चीगतः (१)।
     इन्द्रनीलसच्चित्रकात् क्रमेत समझ्तरम् ॥
     तथापि न परीचार्थ गुवानामभिकृत्यो ।
     मविरश्ची समाधेयः कयच्चिदपि कथन ॥
     चित्रमाता(ऽ)परिचाने दाइदीयेख दूवितः ।
     सीऽनर्थाय भवेदभर्षः कर्षः कार्यायुक्तया ॥ Garuda.

Cf. "The red ruby, at a high temperature, is colourless; or cooling it first becomes green, after which it gradually assume: its original fine red colour." (Bauer and Spencer). "The blus colour of the sapphire disappears on heating."—Ibid.

### GENERAL AND CONCLUDING REMARKS.

The crystalline character of the minerals is referred to in one or two places. All the old writers agree in describing the diamond as having 6 angles. 8 faces and 12 edges. The octahedral form of the crystal is common in the diamond occurring in the neighbourhood of Panna in Bundel Khand. Rājanighantu further adds that the stone is often endowed with numerous faces and edges. According to Basaratnasamuchchaya the female diamond is flattened and rounded whilst the neuter is rounded and obtuse-angled to Vaikranta is also

<sup>.</sup> कोका: पार्श्वानि धाराय यष्ट्री दादशेति । Garuda.

<sup>+ &</sup>quot;In most cubes of diamond, however, each edge is replaced by two faces,...... the twenty-four faces thus derived would, if produced or enlarged" sufficiently, give rise to the form known as the four-fac.d cube, or tetrakis-hexahedron. (Bäuer and Spencer).

<sup>‡</sup> The rendering of the description of diamond in R.R.S.(wide Vol. i, p. 100) is based upon a misreading. The correct reading is that adopted by the Poona edition, namely, अष्टासं वाष्ट्रकार्थ "a diamond has 8 faces and 6 angles." The author evidently uses पृष्ण and पृष्णक in the same sense; there cannot be any confusion here, as distinct mention is made of the 6 angles. As a rule पृष्ण and कीच 'are used synonymously. Thus in Varáha वृष्ण is described as पृष्णि ; the commentator Bhaffotpala explains it पृष्ण किस्तिक्षक पृष्ण पृष्ण ; "Rounded" (वृष्ण) ; Cf. Bauer and Spencer. "The faces of diamond crystals differ from those of most other crystallised minerals, in that they are as a

(probably a mineral of the spinel group. vide Vol. i, p. 83) described as having 8 faces and 6 angles.

It is sometimes asserted that the phosphorescence of diamond was first observed in 1663 A. D. by the celebrated Robert Boyle. Bhoja (11th century A.D.), however, mentions this property.\* Faults in precious stones due to isolated grains of minute gravels etc., embedded in the mass [now technically called "enclosures"], are also referred to.†

It may be noted here that what is generally known as the Indian or Tavernier's rule for determining the value of diamond can be traced back to a remote date. Sukranīti speaks of it as the "rule of squares,"; while Varāha, himself a great

rule, much curved and rounded instead of being perfectly plane as is usually the case." p. 119. "Obtuse-angled" (कुछलीयार) in the crystallographic terminology should be rendered as "with corners truncated off."

- \* प्रवार च दीवत ( phosphoresces in the dark).
  - † कलुवा सन्दश्वयी चिखाकीर्याः सभावतः खखाः । दर्विता न मनीजाः समर्करायेनि मणिदीवाः ॥ Barába.

Here guing; and gusty; no doubt refer of the minute pebbles (gravels ) enclosed in the body of the stones.

‡ यथा गुरुतरं वज् 'तन्त्र एवं रितवर्गत: i. e. if a diamond weighing I rati be worth x, one of the weight of 4 ratis will be worth 2×x. mathematician, gives practically the same rule, though somewhat on an elaborate scale.\*

It would be unfair to compare the progress made by the Hindus in this branch of knowledge in the 6th century A.D. and perhaps earlier with that of the present day. Reference to the crystalline forms of diamond can be found in the writings of Keppler, Steno and Robert Boyle in the seventeenth century. Scientific crystallography originated with Romé de I'lsle and the abbé Haüy at the end of the eighteenth century. The various physical and chemical properties of the minerals culled here bespeak considerable powers of keen observation.†

i. e. if a diamond weighing 20  $\tan d$ ulas (p. 33 ante) be worth 2 lacs (2,00,000), one weighing 5  $\tan d$ ulas will be worth only (5° × 4 = 100)th part of 2 lacs or 2,000.

<sup>†</sup> Concerning Ratnapariksha cf. also "Les Lapidaires Indiens by M. Finot in the "Bibliotheque de l' Ecole des Hautes Etudes."

# NOTE ON THE METHOD OF PREPARING CAUSTIC ALKALI.

In the first Volume of our History the detailed description of preparing caustic alkali from the ashes of plants has been quoted at length from the Susruta and we referred to it "as a proof of the high degree of perfection in scientific pharmacy achieved by the Hindus at an early age." • M. Berthelot has no less been struck with the originality of this process; indeed, he goes so far as to suggest that this portion in the Susruta is evidently modern and in fact a later addition derived from contact with the European chemists.†

The process of rendering mild alkali caustic by the addition of lime is to be found also in Chakrapāni (c. 1050 A. D.) and Vāgbhata, who must have preceded the former by several centuries, and it is well known that both these authors are deeply indebted to the Susruta. There is not thus the remotest chance of inspiration from the European chemists.

<sup>\*</sup> Vide Vol. i, Intro. c.

<sup>†</sup> Journal des Savants, Jan. 1903, p. 42.

We have evidence from quite an unexpected and independent source that the cauterization of bad wounds by means of caustic alkali was an established custom in ancient India. Thus we read in "The Questions of king Milinda":—

"And when the inflammation had gone down, and the wound had become sweet, suppose he were then to cut into it with a lancet, and burn it with caustic. And when he had cauterized it, suppose he were to prescribe an alkaline wash....

Now tell me, O king 1 would it be out of cruelty that the surgeon .... thus cut with the lancet and cauterized with the stick of caustic."\*

<sup>&</sup>quot;Sacred Books of the East," Vol. XXXV, p. 168.
Although Milinda has been identified with the Bactrian Greek king Menander (c. 140—110 B. C.), it is not to be supposed that any Greek influence can be traced in it. In this ethical romance, king Milinda and the Buddhist Bhikshu Nagasena have been put forward simply "as men of straw" to quote Rhys Davids. The work in reality conveys the teachings of the older Buddhists (Hinayanists) with the background of Sawkhya and Vedanta metaphysics.

# The Tantrists, the Rosicrucians and the seekers after truth.

The East has not been always East and the West, West. Modern Europe is materialistic, but she has not disdained in the past to "plunge in thought." This reminds us of the truth of the poet's words: "one touch of nature makes the whole world kin." Ancient Greece had her orphic mysteries. They were developed into a religious and ethical system by Pythagoras. In the schools of Alexandria the neo-Pythagoreans and the neo-Platonists further added to it the Vedantic doctrine of a world-soul.

"With the dissolution of the neo-Platonic school in the sixth century. Greek philosophy disappears, it is true, as distinct phenomenon from the theatre of history, but it continues to exist in combination with foreign elements in the service of a new form of culture in the Science of the Middle Ages and of modern times." (Zeller).

Says Waite :-

"The traditions of the new-Platonic philosophy, with its elaborate theorgical system, were to some extent perpetuated through the whole period of the Middle Ages, for besides the orthodox theology of the great Latin Church and amidst the clamour of scholastic philosophy, we find the secret theosophy of the magician, the Kabbalist, and the alchemical adept borrowing, directly or indirectly, from this prolific fountain of exalted mysticism. The traces of its influence are discoverable in Augustine, in Albertus Magnus, in St. Thomas, the angel of the schools, and in other shining lights of western Christendom, while the metaphysical principles of Johannes Scotus Erigena, even so early as the close of the ninth century, were an actual revival of this philosophy."

History repeats itself. In India the Yoga doctrines of Patanjali paved the way for the origin of Tantric mysticism and it associated itself with magic and alchemy. Some twelve centuries later, this phase in the stage of human progress found exponents in the soil of Europe. As Waite says:—

"In an age of progress, of doubt, and of great intellectual activity, it is singular to remark the almost invariable prevalence of mysticism in one or other of its manifold phases, and the close of the sixteenth century beheld spreading over the whole of Germany and passing thence into Denmark, France, England and Italy, a mighty school of mysticism in the great multitude of magicians, alchemists, &c., who directly or indirectly were followers of the renowned Paracelsus."†

<sup>+&</sup>quot;History of the Rosicrucians," p. 27. Regarding the sect of the Cabalists see also Lecky's "Rationalism in Europe." Vol. i, p. 42. ed., 1900.

<sup>+</sup> See also Kopp's "Die Alchemie in ült. u. neu. Zeit," ii, pp. 1-146, on the "Bekanntschaft mit Geheimnissen der Magie, Theosophie, Alchemie v. A."

Even the lower strata of society in England did not escape the contagion. Sir William Temple observes: "I have had several servants far gone in divinity, others in poetry, have known in the families of some friends, a keeper deep in the Rosicrucian mysteries."

There are those who sneer at the attempts of the alchemists to convert the baser metals into gold and are at the pains to insinuate that the motives of the adepts were sordid. It may be that there have been here and there men-vulgar charlatans-who have pursued the art merely from worldly considerations. The high priests of alchemy, however have in every age and clime been honest seekers after truth. Had there been no desire implanted in the human breast to pry into the hidden and occult mysteries of nature there would have been no science. Whence come we and whither are we destined to go? What is this substance made up of, and what are its ultimate constituents, and what will its combination with this or that lead to ? These are queries, the solution of which or rather the very attempts to solve which mark the birth of philosophy. Patanjali and Nagarjuna in India and Paracelsus in Europe stand forth as the prominent representatives of

this spirit of inquiry. They have been dreamers, mystics and naturalists all combined in one. Such geniuses have always chafed at the restraints and limitations imposed on frail man and hence their fervid yearnings to peep into regions beyond the ken of our gross senses. As Emerson puts it:—

"The privilege of this class is an access to the secrets and structure of nature, by some higher method than by experience. In common parlance, what one man is said to learn by experience, a man of extraordinary sagacity is said, without experience, to divine."\*

Plotinus heaved a sigh at the soul with its infinite possibilities being caged in a frail and corruptible body. The pursuit of alchemy by the esoteric Tantrist is easily explained. To him it was only a means to an end. "It (mercury) is alone that can make the body undecaying and immortal." We find echoes of the same sentiment in the authoritative literature of the Rosicrucians,

Says Waite :-

"Among the concourse of inquirers, and the clamour of supposed and pretended descoverers, there rose gradually into diserved prominence an advanced school of illuminati,

<sup>\*&</sup>quot;Swedenborg ; or, the mystic."

<sup>+</sup> Vide "History of Hindu Chemistry," Vol. i. Intro. lxxvii and xcv—xcvi.

who, employing the terminology of the turbs philosophorum, under the pretence of alchemical pursuits appear to have concealed a more exalted aim. . . . The student is directed by these writers from the pursuit of material gold to the discovery of incorruptible and purely spiritual tressures. . . Physical transmutation, the one and supreme end of the practical alchemist, sinks into complete insignificance; nevertheless, it is performed by the adept and is a landmark in his sublime progress." 1. c. p. 32.

The sage and seer of Hoenheim had his wrestlings. Should he pursue knowledge for its own sake or for what it bringeth? His evil genius holds out the bait thus:—

"Know not for knowing's sake
But to become a star to men for ever;
Know for the gain it gets, the praise it brings,
The wonder it inspires, the love it breeds."

The spiritual at last triumphs over the base in man. Paracelsus has his revelation, and he bursts forth:—

"Truth is within ourselves: it takes no rise
From outward things, whate'er you may believe,
There is an inmost centre in us all
Where truth abides in fullness: and around
Wall upon wall, the gross flesh hems it in,
The perfect clear perception—which is truth."\*

<sup>·</sup> Browning's "Paracelsus."

In the above delineation the poet has done no more than bare justice to the inward longings of an ideal alchemist, who is only an honest seeker after truth. The spiritual and thought-world has always transgressed all barriers of time and space. Kanāda, Patanjali and Nagarjuna of India and Heraclitus, Empedocles and Plato and the restthey all form a holy fraternity; aye, these prophets and oracles of the intellect telong to a "lofty and sequestered class," "the high-priesthood of the principles of thought from age to age. When at long intervals we turn over their abstruse pages, wonderful seems, the calm and grand air of these few, these great spiritual lords, who have walked in the world,- these of the old religion,-dwelling in a worship which makes the sanctities of Christianity look parvenues and popular; for 'persuasion is in soul, but necessity is in intellect." ".

<sup>.</sup> Emerson : on "Intellect."





# The metals and their loss in weight after calculation.

Very vague ideas prevailed among the Hindu philosophers on the constitutions of a metal and its fate after calcination. We are reminded of the diversity of opinion in Europe before the time of Lavoisier. A metal like every material substance was supposed to be formed of one or more of the five, bhūtas; in fact the earthy or saline element was taken to be predominant in it . and hence it lent itself so readily to calcination, † It should be noted here that by "bhūta" was understood not so much element in the modern connotation of the term certain qualities of individual substances. mercury was regarded as composed of the five bhūtas, † When a metal was submitted to calcination some of its component bhutas escaped, leaving the earthy or saline portion behind ; hence the ash (calx) must weigh less than the original metal itself

<sup>\*</sup> पार्थिया: सुवर्धरजनसम्बनुकासन:श्रिजास्त्रकपाचादय:। Ch. 1.,4. 2 Again in Ch. XLVI (Sátra) 345 et seq. the motals are included among the saline ingredients.

<sup>†</sup> Cf. "For some maintain that gold is solid light, or, at least that the chief ingredient is light, which is rendered solid by mixture with some particles of earth. Were it mere earth it might be calcined by fire strongly urged,—Vol. 1. P. 9.

<sup>‡</sup> पथ भूताका हः त्निशिष्ठलेव सदाशिवः। इति रसार्थवे।

There is, however, no direct reference to be met with anywhere as regards the quantitative aspect of the question so clearly established by Lavoisier.

The proportion of loss which a metal undergoes on ignition was made the basis for determining its purity and we find in the law-books an arbitrary scale fixed. Thus according to Yājūavalkya, "gold is unaffected by fire, while one hundred parts by weight of silver, tin and copper lose (lit. undergo decay to the extent of) two, eight and fifteen parts respectively. This is to be taken as referring not to the roasting (killing) of a metal but simply as allowance made to goldsmiths and other artisans for loss incurred in the shape of dross &c. when it is melted in a crucible.

That copper, lead, tin and other base metals ( राज्याच्य: ) when repeatedly calcined are completely reduced to their calces was well known as will be seen throughout the body of the texts. The passage from Rasendra-chūdámani (p. 14) deserves some notice. Lead of the weight of 30 palas is to be calcined till its weight is reduced to a karsha (= \frac{1}{2} \) pala). Even if it be calcined now one thousand times, it will not undergo further reduction in weight. Our author evidently had his experience of lead derived from argentiferous galena, which would leave

चन्नी सुवर्धमचीचं दिपलं रजते यते।

a residue in the shape of a "button" of silver after the lead had been cupelled off. •

 Similar confusion prevailed in Europe up till the end of the 17th century. The following extract from Robert Boyle's "Concerning the Unsuccessfulness of Experiments" will make the point clear.

"Having, upon occasion, had the curjosity not long since to visit some mines of lead and other metals, I find that there is a great difference, and discernible even to the eye, betwixt the several ores; for instance, of lead, some of which I can show you so like steel, and so unlike common lead-ore; that the workmen upon that account are pleased to call it steel-ore, which being of more difficult fusion than ordinary, they are wont to mix it with other ore, which they call firm-ore, to facilitate the melting of it, And I likewise took notice of an ore, which for its aptness to vitrify, and serve the potters to glaze their earthen vessels, the miners call pottern-ore, and sell it (at least where I saw it digged up) dearer than other ore, from which it differs both visibly enough, and as the workmen affirm in divers other (and those less obvious) qualities; and yet all these ores, after fusion, do pass indiscriminately under the name and notion of lead. In which therefore it is no wonder, that severer inquiries find a great deal of disparity. I remember I did not long since cause some lead-ore to be tried, which being the most promising that ever I saw, made me suppose it might contain some considerable quantity of silver: but though it proved so rich in lead, as to yield after the rate of seventy pound to the hundred, yet one of the most expert artists in Europe could not extract one grain of silver out of it ; whereas the lead of very many mines, being skilfully examined, will leave behind it, upon the test, a proportion of pure silver. And though this quantity of silver be not considerable enough to make such mines as yield it pass for silver mines

### Antimony.

Although there is no direct recognition of antimony as a distinct metal, some sort of allusion to it as a variety of lead is not wanting. The reason why antimony was often confounded with lead is that at first sight stibnite may be mistaken for galena. The mineral sauviranjana or nilanjana was thus indiscriminately applied both to the sulphides of antimony and of lead (cf. vol. 1., pp. 93-95). That nilanjana contained a new metal was often suspected though its nature was not properly understood. Thus in Rasendra-chudamani we have "nilanjana, mined with tikshma (cast iron), and heated several times yields a superior kind of lead which is readily fusible and is of mild black colour.

<sup>(</sup>or, as we are wont to call them mines-royal) because the silver will not quit the cost of extracting it; yet such mines though they pass but for lead mines with the metalist, may appear to be mixt mines to the naturalist, who may meet with divers experiments, wherein the little silver that is in them, may make their lead operate differently from that of those ores, which are wholly destitute of silver."—Edition of 1772, p. 323.

Vide Sans. texts, p. 52. The identical distich occurs also in R. R. S. Cf. vol. 1 p. 119. Cf. also "But to detain you no longer on the subject, give me only leave to strengthen the paradox I have proposed, by the authority of that great and candid chymist Basilins Valentinus, who speaking of antimony, after he hath told us, that there are several kinds of it, and especially two; the one more mercurial and of a golden property, witnessed by the shining streaks εξ beams it abounds with; the

# The preparation known as Svarnasindura or makaradhvaja.

As the "law of definite proportion" was unknown to the ancients, tedious processes were resorted to for the complete conversion of mercury into its sulphide. "Makaradhvaja" even at the present day is a favourite remedy with the Hindu physicians of the A'yurvedic school. Let us follow the recipe as given in Rasendra chintamani: "when quicksilver is killed with an equal weight of purified sulphur, it becomes hundred times more efficacious; when it is killed with twice its weight of sulphur it cures leprosy; when it is killed with thrice its weight of sulphur it cures mental languar; when it is killed with four times its weight of sulphur it removes grey hair and

other more full of sulphur, but destitute of the golden nature that enriches the former; adds, that there is such a different goodness betwixt the several sorts of antimony, as there is betwixt the several sorts of flesh or fish, which, though agreeing in name and, if you please, in nature, do exceedingly differ in point of goodness, which brings into my mind the great difference which I have found, even visible to the eye, betwixt the several sorts of Antimony."—Boyle's work—Le. p. 324.

<sup>\*</sup> If we take the historical meaning of the term "A'yurvedic," the above preparation cannot lay claim to this distinction, for it was unknown at the time of the Charaka and the Susruta and was introduced into the Materia Medica during the

wrinkles; when it is killed with five times its weight of sulphur it cures consumption; and when it is killed with six times its weight of sulphur it is a panacea for all the ills that flesh is heir to. Now 25 parts by weight of mercury can only take up (i. c. combine with) 4 parts by weight of sulphur; the excess of sulphur simply sublimes off unchanged. In the actual preparation of svarnasindura (Lit. vermilion with gold) the mercury is first made into an amalgam with thin gold and then repeatedly rubbed in a mortar with During the process of sublimation sulphur. ( कर्षपातन ) the excess of sulphur volatilises off as we have already explained and the gold in fine particles remains behind as a residue. The lustrous, crystalline, reddish brown sublimate, which collects nearest the source of heat, † has the formula HgS. As there is an erroneous impression about

तुस्ये तु समके जीवें एडाच्छतग्यो रमः। हिन्दी समके जीवें सन्वेतृष्ठहरः परः॥ वित्री समके जीवें सन्वेताद्यविनामनः। चतुर्वेदे तम जीवें सन्वेपित्तनामनः॥ सम्बे पसन्वेद जीवें चदि चयहरी इतः। यहस्ये समके जीवें सन्वेरीमहरी रसः॥ र. च.

<sup>†</sup> Gopālakrishna very properly lays particular stress upon this point.

कीटियलातु मुकासमुर्देलयः दलिं स्वजीत्। पथःसं रससिन्द्रं सर्वरीगेषु योजयेत्॥ दति रसन्द्रसःरसंदद्यः।।

the composition of this drug even among educated people in this country we give below the results of analysis of a sample of "mercury killed with six times its weight of sulphur along with gold."

## Identification of metals by their colouration of flames.

Prominent attention should be drawn to the following extract from Rasarnava (Vol. 1., p. 68.)

"Copper yields a blue flame that of the Tin is pigeon-coloured; that of the Lead is pale-tinted"

We are not aware of similar tests being applied anywhere at such an early period as a qualitative test for metals.

## The age of Bhikshu Govinda the author of Rasahridaya.

There is a belief current in some parts of the Deccan that our Govinda is no other than the celebrated teacher of Sankaracharya. † If there be any historical foundation for the belief Govinda

तकापदिभितनतवरको गुष्ठाया दारै न्ययूजयदुपेल स अंकरार्थः । बाचार दलुपदिदेश स तच तके गीविन्द्रपादगुरवे न गुक्यंतीनाम् ॥

Percentage of sulphur found = 13.89; the calculated amount being 13.79; not a trace of gold could be detected.

<sup>†</sup> The following Slokas are cited from Sankaradigvijaya in support of the above :--

should no doubt be placed in the 8th century A. D. Apart altogether from the question whether at such an early date the progress of chemical knowledge as revealed in Rasahridaya had been attained in India, the colophon at the end of the work would tell against such an hypothesis (Intro. liii). The author distinctly states that he wrote his book under the auspices of the king of the Kirátas and even throws out a hint that he was of the Buddhist persuasion. We have no valid reasons to believe that Sankara, the sturdy champion of Brahminical faith and the mighty dialectician, whose activity proved the ruin of Buddhism in India should have sat at the feet of a Guru of the opposite creed.

न्यासः पराभरसृतः किल स्वयस्यां तस्याकानः ग्रक्तमुनिः प्रवितानुभावः । तिस्वयतामुपयतः किल गौजपादी नीविन्दनायमुनिरसः च शिव्यमृतः ॥ प्रयाव तस्य निकटे किल ग्रास्तजालं \* \* \* \*

यीमच्छंकरदिन्तिजयः, ५मसर्गः, verses १०१ and १०५-६। भागन्दायमसंस्कृतसम्बद्धाः—समादः १२।

In the above Slokas Govindanātha Muni is stated to be the preceptor of Sankara, the former being himself the pupil of Goudapāda, who in his turn was a pupil of Sukadeva, son of Vyāsa, the well-known compiler of the Vedas. The Govinda nātha of the text has been confounded by the commentator, Dhanapati Sāri with the Buddhist Govinda. It is scarcely necessary to take serious notice of the chronological perspective of the author of the Sankaradigvijaya.

## The Mechanical, Physical and Chemical Theories of the Ancient Hindus.

(By Principal B. N. Seal.)

I propose in this paper to give a synoptic view of the mechanical, physical and chemical theories of the ancient Hindus. A chronological survey, even if the materials for it were available, would be here of little account. The origins of Hindu natural philosophy in the speculations of the Brahmanas and the Upanishads, or in the mythology of the Puranas, however interesting from the standpoint of 'cultur-geschichte,' do not come within the scope of the present exposition, which relates to the result of systematic thought directed to the phenomena and processes of Nature. I have therefore confined myself to an account of natural philosophy as expounded in the principal systems of Hindu thought. The Sankhya-Patanjala system accounts for the Universe on principles of cosmic evolution, the Vaiseshika-Nyaya lays down the methodology of science, and elaborates the concepts of mechanics, physics and chemistry. The Vedánta, the Púrva-Mímámsá, and in a less degree, the Bauddha, the Jaina, and the Charvaka systems. make incidental contributions on points of special interest, but their main value in this regard is critical and negative. The principal authorities

followed in this account,—the Vyása Bháshya on Patañjali's sútras, the Samhitá of Charaka, the Bháshya of Prasastepáda, the Várttika of Uddyotakara, and the Vrihat Samhitá of Varáhamihira,—all centre round the Hindu Renaissance, the beginnings of the anti-Buddhist reaction, in the fourth, fifth and sixth centuries of the Christian era. Whenever I have made use of later authors, e. g. Kumárila, Sańkara, Sridhara, Váchaspati, Udayana, Bháskara, Jayanta, Varvara, Raghunátha, Vijūánabhikshu &c.. I have taken care to see (except where the opposite is expressly mentioned) that no idea is surreptitiously introduced which is not explicitly contained in the earlier authors.

The Sankhya-Patanjala System.—This system possesses a unique interest in the history of thought as embodying the earliest clear and comprehensive account of the process of cosmic evolution, viewed not as a mere metaphysical speculation but as a scientific principle based on the conservation, the transformation, and the dissipation of Energy.

Prakriti—the ultimate ground:—The manifested world is traced in the Sankhya to an unmanifested ground, Prakriti, which is conceived as formless and undifferentiated, limitless and ubiquitous, indestructible and undecaying, ungrounded and uncontrolled, without beginning and without end. But the unity of Prakriti is a mere abstraction; it is in reality an undifferentiated manifold, an indeterminate infinite continuum of infinitesimal Reals. These Reals, termed Gunas, may by another abstraction be classed under three heads, (1) Sattva, the Essence which manifests itself in a phenomenon, and which is characterised by this tendency to man ifestation, the Essence, in other words, which serves as the medium for the reflection of Intelligence, (2) Rajas, Energy, that which is efficient in a phenomenon, and is characterised by a tendency to do work, or overcome resistance, and (3) Tamas, mass or inertia, which counteracts the tendency of Rajas to do work, and of Sattva to conscious manifestation.

The ultimate factors of the Universe, then, are (1) Essence, or intelligence-stuff, (2) Energy, and (3) Matter, characterised by mass or inertial.

These Gunas are conceived to be Reals, substantive entities,—not however as self-subsistent or independent entities,—( प्रथान ), but as interdependent moments in every Real or substantive Existence.

Even Energy is substantive in this sense. The infinitesimals of Energy do not possess inertia or gravity, and are not therefore material, but they possess quantum and extensity ( परिवाद-परिकास ).

The very nature of Energy is to do work, to overcome resistance ( रजयसम् समझ्यां), to produce motion. All Energy is therefore ultimately kinetic. Even potential Energy ( रज्यसम्बद्धाः) is only the Energy of motion in imperceptible forms.

The original constituents and their interaction. Every phenomenon, it has been explained, consists of a three-fold arche, intelligible Essence, Energy, and Mass. In intimate union these enter into things as essential constitutive factors. The essence of a thing (sattva) is that by which it manifests itself to intelligence, and nothing exists without such manifestation in the Universe of Consciousness ( universe). But the Essence is only one of three moments. It does not possess mass or gravity, it neither offers resistance, nor does work. Next there is the element of Tamas, mass, inertia, matterstuff, which offers resistance to motion as well as to conscious reflection. ( सम: पुरुष्ट प्रवास).

But the intelligence-stuff and the matter-stuff cannot do any work, and are devoid of productive activity in themselves. All work comes from Rajas, the principle of Energy, which overcomes the resistance of matter, and supplies even Intelligence with the Energy which it requires for its own work of conscious regulation and adaptation. (बचानाधान बहरारामा सकाव्येयननने राजसाइदार: सहसारी सर्वात नीकाचार्य-तस्वय-बियानरम।)

The Gunas are always uniting, separating, uniting again. ( चनी-चनिष्ना: सर्जे, ने पामादिस-क्यांना विशेता वा उपस्थाने ). Everything in the world results from their peculiar arrangement and combination. Varying quantities of Essence, Energy and Mass, in varied groupings, act on one another, and

through their mutual interaction and interdependence evolve from the indefinite or qualitatively indeterminate to the definite or qualitatively deter-गुवा: परखरीपरश्चप्रविक्षाता: संवीतविक्षात्रधर्याय: minate. ( परे इतरैतरोपात्रवेष उपार्कितमुर्भयः।—यासमाध ). But though cooperating to produce the world of effects, these divers moments with divers tendencies never coalesce. In the phenomenal product whatever Energy there is is due to the element of Rajas, and Rajas alone ; all matter, resistance, stability is due to Tamas, and all conscious manifestation to Sattva. ( परस्पराकाकि लेऽपि चर्छभित्रविभागाः - न्यासमाध । चन्यः न्याकादि-भावेन जलादितिऽपि द्रव्ये शकाश्रतुष: सत्त्रस्थेन क्रियागुप: रजस्पन खितिगुणसमस एव-विज्ञानसिद्ध योगवाधिक on ज्यासभाष, ibid-मेवा प्रकार संकीखंत्रे-वानस्पतिसिय तत्त्ववैद्यादरी on व्यासमाध्य ibid )

The nature of the interaction is peculiar. In order that there may be evolution with transformation of Energy, there must be a disturbance of equilibrium, a preponderance of either Energy or Mass-resistance, or Essence over the other moments. The particular Guna which happens to be predominant in any phenomenon, becomes manifest in that phenomenon, and the others become latent, though their presence is inferred by their effect. For example, in any material system at reet, the Mass is patent, the Enrgy latent, and the conscious manifestation sub-latent. In a moving body, the Rajas, Energy, is predominant (kinetic), while the Mass or rather the Resistance

it offers is overcome. In the volitional consciousness accompanied with movement, the transformation of Energy (or work done by Rajas) goes hand in hand with the predominance of the conscious manifestation, while the matter-stuff or Mass, though latent, is to be inferred from the resistance overcome, (वधानवैद्यायाम् उपदक्षितसद्विधाना गुपलेड्य च व्यापारमावेष प्रधानान्त-तित्तानुमिताद्विता:—व्याप्याया)

Beginning of Evolution. The transcendental (non-mechanical) influence of the Purusha (the Absolute) puts an end to this arrest, and initiates the process of creation. Evolution begins with the disturbance of the original equilibrium. How this is mechanically brought about is not very clear. A modern expounder of the Sankhya supposes that the particles of Sattva, Rajas, and Tamas possess a natural affinity for other particles of their own class, and that when the transcendental influence of the Purusha ends the state of arrest, the

affinity comes into play, breaks up the uniform diffusion, and leads to unequal aggregation, and therefore, to the relative preponderance of one or more of the three Gunas over the others. Thus commences formative combination among the Reals, and consequent productive activity. ( ६६००म पारक्ष्यसंथीन: न्यूनाधिकश्रवेन पत्रोग्यं संयोगविश्रेष:। Chap. I. Sútra 66, प्रवचनभाष-विज्ञानिष्णु। पृथ्विषेक्ष्रतेन पृथ्विष्णेक्ष्रेव सत्त्वक्ष्रीनाम् एक्ष्यातीयवया एकता। स्ववातीयोगस्थादिन इविज्ञासादिक्षं स मुक्तम् fbid., Sútra 128, Chap. I).

Formation of wholes or systems—collocation of Reals:—Creative transformation accompanied with evolution of motion (परिवाद) and work done by Energy (किया) cannot take place without a peculiar collocation of the Reals (Gunas). To form wholes or systems (समुद्ध) it is essential that one Guna should for the moment be prependerant, and the others co-operant. And this cannot be without an unequal aggregation which overthrows the original equilibrium ( मुचनेवम, मुनाधिकभाव),—in other words, without unequal forces or stresses coming into play in different parts of the system. (मुपनिवाद—बाचकित।) मान सिक्यं परिवाद्यन्त.....समुद्दयः सम्बादः। स म मुद्दाना मुग्निवान मानकियं परिवाद्यन्त.....समुद्दयः सम्बादः। स मुद्दाना मुग्निवान मानकियं परिवादकानाहते। (बाचकित, कीमुद्दो on káriká 16.)

The Formula of Evolution-Differentiation in Integration.—Evolution (परिषास) in its formal aspect is defined as differentiation in the integrated ( संस्थ- विवेत). In other words, the process of Evolution consists in the development of the differentiated (वेयम) within the undifferentiated (सामानका), of the determinate (विशेष) within the indeterminate (पविशेष), of the coherent (युविषद) within the incoherent (चप्रविषद). The evolutionary series is subject to a definite law which it cannot overstep (परिचामक्रमनियम). The order of succession is not from the whole to parts, nor from parts to the whole, - but ever from a relatively less differentiated, less determinate, less coherent whole to a relatively more differentiated, more determinate, more coherent whole. That the process of differentiation evolves out of homogeneity separate or unrelated parts, which are then integrated into a whole, and that this whole again breaks up by fresh differentiation into isolated factors for a subsequent redintegration, and so on ad infinitum, is a fundamental misconception of the course of material Evolution. That the antithesis stands over against the thesis, and that the synthesis supervenes and imposes unity ab extra on these two independent and mutually hostile moments is the same radical misconception as regards the dialectical form of cosmic development. On the Sankhya view, increasing differentiation proceeds pari passu with increasing integration within the evolving whole, so that by this two-fold process what was an incoherent indeterminate homogeneous whole

evolves into a cohcrent determinate heterogeneous whole.

The different stadia in the order of cosmic Evolution are characterised as follows:—

- (2) The knowable, the empirical universe, cosmic matter of Experience, things as matter or stuff of consciousness (fee ),—comprising Mahat, the intelligible Essence of the cosmos, evolved by differentiation and integration within the formless, characterless, inconceivable Prakriti.
- (3) Individuated but still indeterminate stuff bifurcating into two series—Subject-experience,—comprising on the one hand the indeterminate unity of apperception or the empirical Ego, as the co-ordinating principle of Subject-series ( प्राच्या ), and on the other hand, the indeterminate material potencies, the subtile vehicles of potential Energy (प्राच्या , प्राच्या), the ultimate subtile constituents of the Object-series (the material world). The previous stadium, the cosmic matter of Experience ( विका, प्राच्या ) evolves within itself,

by differentiation and integration, an individuated but still indeterminate stuff in two co-ordinated series, Subject and Object.

- (4) Determinate stuff (faun) evolved within the indeterminate by further differentiation and integration, viz., in the series of Subject-experience, sensory and motor stuff; and in the Object series, a corresponding atomic matter-stuff actualising the material potencies in the form of specific sensible Energies. The latter includes the different classes of Paramänus, the different kinds of atomic constituents of different kinds of gross matter ( want).
- (5) Coherent and integrated matter-stuff, individual substances, characterised by generic and specific properties, which however are not rigidly fixed, but fluent being subject to a three-fold change and constantly evolving, (অনুবাধরাক্যন্থনিয়ারার অনুত: হল্লনিবি ঘরস্থাল:—আন্তমান্দ, Sútra 44, Chap. III. নানাক্ষিত্তন্ত্রাহালী হল্লা—আন্তমান্দ, ibid. নানাক্ষিত্রালাল ক্রাটী ধন্দ্রী, ibid. ধর্মিয়া ধর্মকল্লাবক্যাব্যিয়াল:).
- (6) And so the cosmic series moves on in ascending stages of unstable equilibrium (বিভত্তম্ববিশাস) until the reverse course of equilibriation and dissipation of Energy

(बहुत्तपरियास and साम्यावस्था) which even now constantly accompanies the evolution and transformation of Energy, completes the disintegration of the universe into its original unmanifested ground, the unknowable Prakriti.

The order of Cosmic Evolution according to the with (Sútra 19, Páda II) is shown below, in a tabular form:

Prakriti, the unmanifested unknowable ground ( गृदमध्यक्रमस्विद )

Cosmic matter of experience ( 454, fee )

Subject series (पविषय) Object series
Individuated indeter- Individuated Luc
minate mind-stuff determinate matter-stuff
(unity of apperception (subtile material potenempirical Ego, पदिवास) cies, सन्याय)

Determinate mind-stuff Determinate matter-stuff (विशेष) sensory and (विशेष) atomic and molemotor psychoses, etc. cular constituents of gross (बालेन्द्रिय, कर्योन्द्र्य and सनः) matter (परमाय —स्यूसमृत)

Coherent and integrated matter-stuff (चयुतसिद्धावयव: समुद्र: सद्भात: दर्ज )

Individual substances, with generic and specific characters subject to constant change or evolution e.g. inorganic objects composed of atoms or molecules ( परमास ), vegetable organisms ( क्स), animal organisms ( क्सेर ) ( चमुलस्झावयव: सङ्गत: मरीरं क्स: परमास्थित—आसभाव. Sútra 44, Páda III).

तव तत् संखरं विश्वित कमानांत्वनीः, तथा वव्यविश्वाः लिङ्गावे संखरा विविचनी, परिचानकमनियमात्, तथा तेषु चित्रविषु मूतेन्द्रियाणि संख्यानि विविचनी, न विश्विध्यः परंत्राचानरमसि तेषान् धर्मानच्या-रखापरिचामा व्याख्यायिकाने (व्यासभावः, Sútra 19, Páda II).

N.B.—The usual order given in the Sankhya compendiums is as follows:—Prakriti, Mahat, Ahankars,—and then the bifurcation, viz., 11 organs sensory, motor and common sensori-motor from Rajasic Ahankara, and Tanmatras from Tamasic Ahankara,—and finally the Paramanus of the Sthula-Bhutas.

The conservation of Energy (and of Mass)—the transformation of Energy :—

The Gunas (Reals), though assuming an infinite diversity of forms and powers, can neither be created nor destroyed. The totality of the Mass (Tamas), as well as of Energy (Rajas) remains constant, if we take account both of the manifested and the unmanifested, the actual and the potential. But the individual products of the evolutionary process, the concrete phenomenal modes resulting from the combined action of the original Mass, Energy and Essence, are subject to addition and subtraction, growth and decay, which are only due to changes of collocation, and consequent changes of state from the potential to the actual, (in other words, from the future to the present and from the present to the past, in a time series)-changes, which are illusorily ascribed to the Reals themselves. The different collocations of Mass and Energy give birth to the divers powers of things, the various forms of Energy which may be classed as like and unlike ; indeed the course of Evolution from the Reals conforms to a fixed law, not only as regards the order of succession, but also as regards the appearance mutual relations) of like and unlike Energies. this transformation is constantly going on,-the course of Evolution is not arrested for a moment.

गुणान् सर्व्यक्षांत्रपातिनः न प्रश्नसम्बने नीपनायने व्यक्तिभिरेत्र क्रिताऽनागतव्ययानस्वतीभिः गुणान्यिनीभिः उपजनापाद्यक्षेत्रा १व प्रश्नभावने (व्यासभाष, Sútra 19, Páda II). परिचानिनित्यता गुणानाम् । सर्व्यमिदं गुणानां सन्निवेशविशेषमात्रम् (ibid, Sútra 13, Páda IV). एते गुणाः तुल्यजातीयातुल्यजातीयस्विभेदानुपातिनः (ibid., Sútra 19, Páda II). परिचामक्रमनियमात् (व्यासभाष, Sútra 19, Páda II ). इसायल' परिषामायले हेतु. ( Patuñjali Sútra 15, Páda III ). एकति: परिषमगदीला चयमध्यपरिषम् गार्वतिहते।

The doctrine of Causation, a corollary from the conservation and transformation of Energy:—the principle of collocation—the storing-up and the liberation of Energy:—

The Sankhya view of causation follows at once as a corollary from this doctrine of the conservation and transformation of Energy. As the total Energy remains the same, while the world is constantly evolving, cause and effect are only more or less evolved forms of the same ultimate Energy. The sum of effects exists in the sum of causes in a potential (or un-evolved) form. The grouping or collocation alone changes, and this brings on the manifestation of the latent powers of the Gunas but without creation of anything new. What is called the (material) cause or sum of material causes is only the power which is efficient in the production or rather the vehicle of the power. This power is the unmanifested (or potential) form of the Energy set free ( चहुतज्ञीच ) in the effect. But the concomitant conditions are necessary to call forth the so-called material cause into activity. When the favourable combination or co-operation of concomitants is wanting, there is no manifestation of the effect. The question is-what is the aid which the concomitant conditions render to the deter-

mination (and production) of the effect existing in potency in its material cause ? First there is the merely mechanical view as illustrated by some commonplace examples, e.g., the manifestation of the figure of the statue in the marble block by the causal efficiency of the sculptor's art, or of the oil in the sesamum by pressing, or of the grain of rice out of the paddy by the process of husking. In these cases the manifestation of an effect is only its passage from potentiality to actuality, a stadium in the process of evolution from possible (future) existence to accual (present) existence ; and the concomitant condition ( सरकारियांक ) or cause ( निमित्तकारण ), the sculptor's efficient chiselling, the pressing, the husking, is a sort of mechanical or instrumental help to this passage or transition, कार्यमिक्सभिव उपादान-कारपालम् । सा मितः कार्यस्य धनागताबस्था एव । स एव विशेष: (खताने: प्रांक कारवी विशेष:) धकासि: कार्यस चनागतावस्था इत्वचते (विज्ञानसिष्ट-प्रवचनभाष, Sútra 115, Chap. I ). चमिन्नक्ति: वर्शनानावस्था । कारवन्यापारीप्रवि कार्यसै वर्शमानलच्यपरिचाममेव लन्यति । यथा त्रिश्वामध्यस्यतिमायाः लेहिकः व्यापारेच पश्चित्रात्रमार्थ तिलसातैलस च निचीदनेन धानस्तत्रस्यस च चवचातेन (विज्ञानिभिष-प्रवचनमाथ, Sutra 129, Chap. I).

These mechanical exmples of the Kapila-Sāńkhya have the merit of simplicity, but the Patańjali-Sāńkhya brushes them aside, and explains causation on the basis of the conservation and transformation of Energy, advancing it as the liberation of potential Energy existing stored up in a Guna collocation, (the sum of material causes) the liberation following on the action of the proximate efficient cause, or concomitant conditon ( किंक्सकारय ).

The causal operation of concomitant conditions (efficient causes) lies only in this that they supply a physical stimulus which liberates the potential Energy stored up in a given collocation. Everything in the phenomenal world is but a special collocation of the ultimate Reals (Energy, Mass and Essence). The sum of (material) causes potentially contains the Energy manifested in the sum of effects; and in the passage from potency to actualisation, the effectuating condition (the concomitant cause) when it is itself accomplished, is only a step in the evolutionary series, which adds a specific stimulus, and renders determinate that which was previously indeterminate. the effectuating condition is added to the sum of material conditions, in a given collocation, all that happens is that a stimulus is imparted, which removes the arrest, disturbs the relatively stable equilibrium, and brings on a liberation of Energy (ভঃ বঃবিম্নির) together with a fresh collocation (गणसजिवेशविशेष'. सर्वेभिद गुगानी सन्निवेशविशेषमावस इति प्रमायेती गुषात्मान: (व्यासभाष, Sótra 13, Páda IV), सत्तद प्रस्ता निमित्त वर्षमानीकरणे समधे न चपुर्धीयजनने । सिद्धं निमिशं नैनिश्चिका विश्ववातुबद्दण क्रेने । नाण्यास्तादवति (व्यासभाषा, Sútra 12, Páda IV ).

Describing the production of bodies ('organic vehicles') for individual souls, out of matter of Prakriti, under the influence of their merit and concomitant conditions, Patanjalı demerit, as points out that non-material concomitants like merit and demerit do not supply any moving force or Energy to the sum of material conditions, but only remove the arrest (the state of relatively stable equilibrium) in a given collocation, even as the owner of a field removes the barrier in flooding his field from a reservoir of water. This description is intended to represent the super-physical influence of non-material concomitants (or causes) like volition, merit and demerit, etc., but the causal operation of a material concomitant condition is essentially the same ;-there is the same reservoir of stored-up Energy in a given collocation.-the same condition of arrest or relatively stable equilibrium,-the same liberation of the stored-up potential Energy which flows along the line of least resistance ;-the only difference being that in the case of material concomitants the stimulus which removes the arrest is physical, instead of being transcendental as in the case of non-material causes like will, merit and demerit, etc.

The Vyasa-bhashya helps us to a clear mental representation of the details of this process, being perhaps the finest example before Newton of the exercise of a Scientific Imagination, and as memorable as any in the whole history of thought containing as it does the theory of potentials as in a nutshell :- As the owner of many fields can irrigate, from a field which is already flooded, others of the same or a lower level, without forcing the waters thereto with his hands, and merely by making an opening in the barrier or dyke, on which the waters rush in by their own force :- or further, as the same person cannot force these waters, or the earthy matters held in solution therein, into the roots of the rice plants, but only removes the obstructive grasses and weeds, on which the fluids their own power enter the roots ;-such is of the action of an effectuating condition ( निनम ) added to a sum of material causes or conditions.

निमित्तम् अप्रयोजकं प्रश्नोतां वरणसेद्यः ततः चेचिकवत् (Patoājali Satra 3, Páda IV). न द्वि धर्मादि निमित्तं यथा चेविकः केदारात् अपा पूरणात् केदारे पिश्लाविषुः समं निम्न वा निम्नतरं वा नापः पादिनापकर्षतः भावरचं तु भासां सिनत्ति तिमन् सिन्ने स्वयनिवापः केदारा करम् भाशावयन्ति ।

Chain of Causation—fixed order.—The order of Evolution with the transformation of the Energies follows a definite law. The unalterable chain of causes and effects in the phenomenal world illustrates this fixed order. But though the cosmic order is one and fixed, it comprehends divers series arising from different combinations of the original Gunas, which constitute subordinate or particular laws of cause and effect (क्रवायन परिषासायने देव:, Patanjali Sútra 15, Pada III).

What we call the qualities of things are only modes of Energy acting in those collocations यीग्यताविष्यता धियाय: प्रशिति धर्मा:- स च फलप्रसवभेटानमित्रकृष्टाव: (व्यासभाष, Sútra 14, Páda III ). ते खलमी धर्मा वर्धमाना व्यक्ता-बानः, पतीताहमानताः मुखाब्यानः सर्वमिदं स्थानां सदिवेशमावसिति वरमार्थती गुवाल्यानः (STEHIS, Sútra 3, Páda IV). And these various Energies are sometimes (kinetic), sometimes potential, rising to actuality. and sometimes sublatent, subsiding from actuality into sublatency. In fact, the original Energy is one and ubiquitous, and everything therefore exists in everything else, potentialiter ( सर्व' स्थां कालानि ). without prejudice to the generic and specific differences of things ( काम्बनुक्दिन सर्वे सर्वासके ), Inorganic matter, vegetable organisms, and animal organisms are essentially and ultimately one (जलभ्योः पारिचामिनं रसादिवैक्टलं स्थावर्षि हर्षं हथा स्थावराची सबसेव सब्भागी खावरेष ) so far as Mass and Energy are concerned, but the varied forms of Energy and the generic and specific qualities (or properties) of things, which are but modes of Energy, follow a definite unalterable law in the order of their appearance and succession, under conditions of space, time, mode and causality, and hence all effects do not manifest themselves at once देशकालाकारनिमिधापवसात न खल समानकासम बात्रामधिकाति: (ibid, Satra 14, Pada III . मी मन धर्मान समनकरी धर्मा स तस कम:। पिक: प्रचारते घट उपवासी इति धर्यप्रशिकासहमः । लच्यापरिकासक्षमः घटसः भगानतभावात् वर्तमान-भावकमः, तथा पिरास वर्शमानभावात पतीतभावकमः (व्यासभाव, Sútra 15, Páda III ).

Time, Space, and the Causal series :-

A Tanmatra (infra-atomic particle of subtile matter) is conceived by our understanding to stand in three relations—(1) position in Space (ইমাৰ্থাছঃ), (2) position in the Time-series (কালাৰ্থাছঃ) and (3) position in the causal series (বিনিয়াৰ্থাছঃ).

These three relations are the work of the intuitive stage of knowledge as opposed to the conceptual ( विकित्तव्यक्षण as opposed to स्विकत्यक्षण ). But this is not the pure relationless intuition of Reality ( विकित्यक्षण ) which may be termed intellectual intuition, but the intuition that imposes its forms on the Real substrate ( स्वयः रा विकित्यक्षण ) or in other words empirical intuition. तब स्वतः कृष्ण पश्चित्रक्षण विकित्यक्षण विकि

Infinite Time is a non-entity objectively considered, being only a construction of the Understanding (द्वितिष्टेष) based on the relation of antecedence and sequence in which the members of the phenomenal series are intuited to stand to one another. These phenomenal changes as intuited by us in the empirical consciousness fall into a series, which the Understanding conceives, as order in Time. The Time-series, then, is a schema of the Understanding for

representing the course of Evolution. schema of the Understanding supervenes the phenomenal world as order in time, and hence in the empirical consciousness the Time-series appears to have an objective reality, and to form a continuum. As there is an ultimate and irreducible unit of extensive quantity (परिवाद) in the Gunas or infinitesimal Reals of Prakriti, which are without constituent parts, so the moment may be conceived as the ultimate and irreducible unit of this time-continuum as represented in the empirical consciousness. A moment therefore cannot be thought of as containing any parts standing in the relation of antecedence and sequence. If change is represented by the Time-series, a moment as the unit of time may be supposed to represent the unit of change. Now all physical change may be reduced to the motion of atoms in Space, and we may therefore define the moment as representing the ultimate unit of such change -viz., the (instantaneous) transit of an atom (or rather a Tanmatra) from one point in Space to the next succeeding point. Even an atom has constituent parts (the Tanmatras), and hence an atom must take more than one moment to change its position. The motion of that which is absolutely simple and without parts from one point in Space to the next must be instantaneous. and conceived as the absolute unit of change

(and therefore of time, चच ). If this is held to be an irreducible absolute unit, it will follow that what we represent as the time-continuum is really Time is of one dimension. Two modiscrete. ments cannot co-exist. Neither does any series of moments exist in reality. Order in Time is nothing but the relation of antecedence and sequence, between the moment that is, and the moment that went just before. But only one moment, the present, exists. The future and the past have no meaning apart from potential and sublatent phenomena. One kind of transformation, to which a thing is subject, is that it changes from the potential to the actual, and from the actual to the sublatent. This may be called the change of mark (अजवापरियाम) as opposed to charge of quality (धर्मपरियाम), and the change due to duration or lapse of time ( चवस्वापरियाम ). The present is the mark of actuality,- the future, the mark of potentiality,-and the past, of sublatency,-in a phenomenon. Only one single moment is actual, and the whole Universe evolves in that one single moment. The rest is but potential or sublatent.

चणतम्बन्धोनीकि वज्रसमाद्यार इति वृद्धिसमाद्यारः सुक्रमीद्योगादयः । स खल्यं भावः वज्रस्यो वृद्धिनिक्षायः अन्द्रभागत्याती स्वीकिकानां स्वत्यायस्यानन्यांकाः । तं कालिक्टः काल इति भाषत्तते शीमिनः । न च तो चणी सद्द भवतः, काल्य न दयोः सद्द्रभुवीरस्थायात् पूर्णयादुत्तरभाविती यदानन्त्ये चष्या स कमः। तसात् वर्षमान एवेकः चणः न पूर्वो सर्च्याः सनीति क्यावाणि तक्षमाधार: । ये तु भूतभाविन: चणा: ते परिचामान्तिता व्याख्या: । तेन्त्रेन चणेन क्षत्वो लीव: परिचामसनुभवति, तत्वचावदा: स्वसमी धर्या: । यथाऽपकर्षपर्थंनां द्रव्यं परमाण: एवं परमापकर्षपर्थंना: काल: चण: । यावता वा समयेन चलित: परमाण: पूर्वंदेशं जन्मात् उत्तरदेवम् उपसम्बद्धेत स काल: चण:तत्ववाद्याविष्कंदस्तु कमः । (व्यासभाव्य Sutra 52, Pada III.)

Vijinaa-bhikshu points out that this does not amount to a denial of Time. It means that time has no real (or objective) existence apart from the 'moment'. But the latter is real, being identical with the unit of change in phenomena (गुपपरिचासस स्पत्र-स्वात्). But even this is real only for our empirical (relative) consciousness (अध्याद्यांत्र), which intuits the relation of antecedence and sequence into the evolving Reals (Gunas), in the stage of 'empirical intuition' (हिन्दार विकित्यामा). The 'intellectual intuition' (विविधार विकित्यामा) on the other hand, apprehends the Reals as they are, without the empirical imported relations of Space, Time and Causality.

Space as extension and Space as position :-

Space must be distinguished as Desa (locus, or rather extension) and Dik (relative position). Space (Dik) as the totality of position, or as an order of co-existent points, is wholly relative to the Understanding, like order in time, being constructed on the basis of relations of position intuited by our empirical (or relative) consciousness. But there is this difference between Space-order and Time-order:—there is no unit of Space as position (Dik),

though we may conceive a unit of Time, viz., the moment ( चया regarded as the unit of change in the phenomenal or causal series (परमाणुक्तिया or 'मृष्परिचामस्य चयनवन्तान्—योगवाधिक, Sutra 51, Pada III). Spatial position (Dik) results only from the different relations in which the all-pervasive A'kasa stands to the various finite (or bounded) objects. On the other hand, Space as extension or locus of a finite body, Desa (देश: क्लिंग्यारः), has an ultimate unit, being analysable into the infinitesimal extensive quantity inherent in the Reals (Gunas) of Prakriti. (मृष्प्रकृति-रक्षपरिचान:—योगवाधिक: पत्र क्लिंग्यादिव्यवद्यारक दिग्रपाधिकिय सम्बात सामान्यतः कालदिग्यवद्यारकवेऽपि भाषाञ्चादेव तद्यपरिच । कालाम दिग्रसं विशेष: यत् काल: खबदप इच्छी, दिक् तु सळेचेव नेव्यते ।

The Casual series .- The relation of Cause and has been already explained. It only Effect remains to add that the category of causality is mediated through the schema of order in Time. The Empirical Intuition first superimposes relations of antecedence and sequence on changing phenomena (the evolving Gunas or Reals). Understanding of these out and the tions creates order in Time. The Empirical Intuition then intuits the phenomenal series of transformations of Energy in this Time-order and in so doing, imports the relation of cause and effect into the course of Nature. (कार्यकारसभावादीना दयघटितलान-धोनवाभिन, Sutra 51, Pada III).

The dissipation of Energy (and of Mass)-their dissolution into the formless Prakriti: - Cosmic Evolution ( पिश्वाम ) is a two-fold process, creative as well as destructive, dissimilative as well as assimilative, katabolic as well as anabolic (पत्रजीमसर्ग and विशेषसर्थ, विसहस्परियास and सहस्परियास). In one aspect, there is the aggregation (anequal aggregation) of Mass and Energy, with consequent transformation of Energy, resulting in the creation of inorganic as well as organic matter, and the genesis of worlds. The successive steps of this process may be described as (1) unequal aggregation with storing-up of Energy in a certain collocation, under a state of arrest (i.e., in a state of relatively stable equilibrium), (2) a stimulus removing the arrest, and disturbing the equilibrium, and (3) liberation of the Energy. moving on to a fresh collecation, fresh aggregation, arrest and equilibrium. The process of the world thus moves on from equilibrium to equilibrium, and the result of that process is the development of a coherent determinate heterogeneous whole (लिड अविशेष विशेष, यमुतसिदायअवसम्ब, मुतसिदायमसम्ब) in what is essentially an incoherent indeterminate homogeneous whole (wim w).

But there is a second aspect of this evolutionary process. Unequal aggregations are unstable, there is a constant tendency in things to go back to the original stable equilibrium,

the state of uniform equal diffusion of Reals. This process is called the resolution of like to like ( सटप्रपरिकाम ), consisting in assimilation and dissipation, and being the exact opposite of the process of "differentiation in the integrated" which has evolved the Cosmos. The collocations of Mass, Energy and Essence are always breaking up, and the Energy as well as the Mass, however slowly, however imperceptibly, are being dissipated, i. e., dissolved into the original formless Prakriti, a state of permanent equilibrium and arrest, from which there is and can be no return, except under the transcendental influence of the Absolute at the commencement of a new creative cycle. Not that there is a destruction of the Mass or Energy, but a dissipation or dissolution into a condition of equal uniform diffusion from which there is This is not the phenomenon of kinetic no return. Energy disappearing and becoming potential sublatent, for in such cases there is restitution or reconversion by natural means. When this reverse current of assimilation ( and dissipation ) prevails over the current of dissimilation ( and integration ), the Universe will disintegrate more and more, until it disappears in the formless Prakriti, its unknowable source and ground (तत्त्वव and कीम्दी).

The Evolution of matter ( तान्याविक सृदि ) :— The ultimate constitution of Matter is a question jala system. Three stages clearly stand out in the genesis of Matter:—(1) the original infinitesimal units of Mass or inertia, absolutely homogeneous and ubiquitous, on which Energy does work, when the original equilibrium comes to an end (स्वाद—सामग्रकार). (2) The infra-atomic unit potentials, charged with different kinds of Energy, which result from the action of Energy on the original units of Mass, (बनाब), and (3) the five different classes of atoms, the minutest divisions of which gross matter is capable, but which are themselves complex Tanmátric systems (स्वाद्ववपरमाष्ट्र).

The first stadium Bhutadi is absolutely homogeneous and absolutely inert, being devoid of all physical and chemical characters ( दपादिभिरसंयुनं ) except quantum or mass (परिक्टिन, परिमाण); and this admits neither of addition nor of subtraction, can neither be created nor destroyed. The second stadium Tanmatra represents subtile matter, vibratory, impingent, radiant, etc., instinct with potential energy. These potentials arise from the unequal aggregation of the original mass-units in different proportions and collocations with an unequal distribution of the original Energy (Rajas). ( तन्त्राच क्यादी: जिंकारयम् इति चेत् सकारयद्वन्यायां न्यनाविकशादेन कनीनां पति संबोगिवजेष एव-सजातीयोयसमादिना हिंदुजासादिकां च युक्तं. ) The Tanmatras possess something more than of Mass and Energy. They possess quantum physical characters, some of them penetrability

( परकाशदान ), others powers of impact or pressure, others radiant heat, others again capability of viscous and cobesive attraction. In intimate relation to these physical characters they also possess the potentials of the energies represented by sound, touch, colour, taste and smell, but being matter they are devoid of the peculiar forms (faxe) which these potentials assume in particles of gress matter like the atoms and their aggregates. In other words, the potentials lodged in subtile matter must undergo peculiar transformations by new groupings or collocations to be classed among sensory stimuli,-gross matter being supposed to be matter endued with properties of the class of sensory stimuli, though in the minutest particles thereof the sensory stimuli may be infra-sensible ( पतीन्त्र but not पत्रत ), (तांबांसांबास् तन्त्राताः ते च पविश्रेषिणः । ते च पदार्थाः शानधीरमुदःख्येः सालगतः मन्द्रादिविभेषे: मना एकदपतात । तथा च मानःदिविभेषग्रनाभन्दःदि-मध्यमेव भृतानां प्रव्हादितन्यावलम् ।)

The Tanmairas, then, are infra atomic particles charged with specific potential energies,—first, the potential of the sound stimulus is lodged in one class of particles, Tanmatras which possess the physical energy of vibration (परिषद ) and serve to form the radicle of the ether atom (पाषापरमाद ), then the potential of the tactile stimulus is lodged in another class of Tanmatras, particles which possess the physical

energy of impact or mechanical pressure in addition to that of vibration and serve to form the radicle of the gas atom (Váyu Paramánu) ;-next, the potential of the colour stimulus is lodged in a third class of Tanmatras, particles which are charged with the energy of radiant heat and light in addition to those of impact and vibration and serve to form the nucleus of the light and heat corpuscle; then the potential of the tastestimulus is lodged in other Tanmatras, particles which possess the energy of viscous attraction. in addition to those of heat, impact and vibration, and which afterwards develop into the atom of water, and lastly, the potential of the smellstimulus is lodged in a further class of Tamátras. particles which are charged with the energy of cohesive attraction, in addition to those of viscous attraction, heat, impact and vibration and which serve to form the radicle of the earth-atom.

वर्षकीयाः तदावा प्रव्यतन्तातं स्वर्थतन्तातं स्वतन्तातं प्रवादिक्षेत्राः। स्वास्थायः Sutra 19 Pada II स्वतन्तात् प्रव्यतन्तातं प्रव्यतन्तातं प्रव्यतन्तातं प्रव्यतन्तातं प्रव्यतन्त्रातं स्वतन्त्रातं प्रव्यतन्त्रातं स्वतन्त्रातं स्वतन्ति स्वतन्ति

शन्दादीनां मृत्तिसमानवातीयानाम् एकः परिचामः पृथिवीपरकाणः तमावावयवः। स्तान्तरेषु चित सेष्ठीच्याप्रगमिलाऽवकाशदामानि खपादाय सामान्यम् एकविकारारम्यः समाधेदः। (व्यासभावः Sutra 14. Pada IV.) तदाया। सम्बद्धनात्रे वर्ज्यस्था चतुष्ठनात्रायां चेष्ट्रणतीयानाम् एकः परियामः जलपरमायुः तेषां च महाजलादिः, एवं गश्रदमी वर्जाविला भीषाजातीयानां विवद्मावायां तेजोऽगः तेषाः सहातेज्ञवादिः। एवं गश्रदस्वपायां वर्जनात् दास्यां वायुषः तेषाः सहावायुःदिः। एवं प्रस्तस्याधा-दहरारोष्ट्रस्तातात् पाकामाषः तेषाः सहाकःशादिः।

विज्ञानभिशु remarks:—धन दर्भने धर्य विद्वानः प्रव्हादिः तकः वयस्य काठिन्यस्य प्रदारः प्रविदेशदिनातयः सन्ति । (वीगवार्त्तकः Sutra 14, Pada IV.)

Before explaining the genesis of atoms, it is necessary to say something about A'kása, which is the link between the infra-atomic particles (Tanmátras), and atoms (Paramánus). A kása corresponds, in some respects to the ether of the physicists and in others to what may be called proto-atom (protyle). In one respect A'kása is all-pervasive ( fan ), and devoid of the proof impenetrability which characterises even the infra-atomic potential units (Tanmátras), In another aspect, A'kása is described as having originated out of the mass or inertia in Prakriti (Bhútádi) when the latter became charged with the first potential vibration (the sound-potential). Vijňána-bhiksnu in the Voga-Vártika boldly tackles the difficulty. A'kása, he explains, has two forms, original and derivative non-atomic and atomic. The original A kása is the undifferentiated formless Tamas (mass in Prakriti, matter-rudiment-Bhútádi) which is devoid of all potentials, and is merely the all-pervasive seat or vehicle of the ubiquitous original Energy (Rajas). This A'kása

must not be confounded with vacuum, which is merely negative ( कावरकाभाव-un-occupiedness ). all pervasive, though it must be conceived 88 occupying the same space as the various forms of gross matter (समानदेशकम्—घनकाशसद्यम् धाकार्थ-योगवार्शिक). and therefore devoid of the property of impenetrability ( मृत्रीनरासमानदेशलं-शोगवार्त्तिक ) which characterises atomic matter. But when the original equilibrium (सम्बाद्धा ) comes to an end, unequal aggregations form collocations in different groups and proportions of the three Gunas (बनाधिकभावेन चनीन संवीतविशेष: संहतन - विद्यानभिष्, प्राचनभाषा and शीनवार्णक । The transformation of Energy now begins, - working on a collocation of mass (with Essence) (युवाकरीय-समार्थ सर्वात:- विकासिन्द, शीमवार्थिक); it first gives rise to the sound potential (अञ्चलनवां खादंब्येण परिचमतिfamining ) and the atomic Akasa (proto-atom. protyle) is but an integration of the original unit of mass charged with this vibration potential. This vibratory (or rather rotary) ether-atom ( पाकामाच ) is integrated, limited ( परिच्छित ) and as such cannot occupy the same space with other ( subsequently integrated ) atoms. But this protoatomic integration of A'kasa (কাজাজাত) is formed everywhere, and itself residing in the ubiquitous non-atomic A kása ( कारणाकाम-चवकामस्पनाकार्य ) forms the universal medium in which air or gas atoms, light and heat corpuscles, and other atoms move and float about. (वाबीरावरणं । यदि हि पवसाध्रद्धम 'बाकार्थ

न सात् तदा मूर्णद्रव्येषु स्त्राच्यादिषु सनके जचादि विद्यो न सात्— विद्यागिभस, योगवार्षिक Sutra 40, Pada III, सामार्थ दि कार्थकारसक्षीय दिविधम्। तत कारणाकाशं तमीगुण्यविश्वत्येव व्यविद्यते। तदाशीम् साकाशताव्यक्षकशब्दादिगुण्यविश्वेषाभावात्। तस् कारणाकाशं नुषान्यसम्बद्धं सदंग्रतः सादौ शब्द अनगरीग्यार्थकपेण परिचमने तत्य स्युसङ्कातेन पृष्ठिवेवदेव सङ्गम्ताकाशः स्टक्कारप्रिया परिचान वाग्रीरावरसम् सम्बद्धते (विद्यानभिष्युत्योगवार्षिक, Sutra 41, Pada III)

The generis of the infra-atomic unit-potentials (Tanmátras) and of the atoms.

The subject of the genesis and the structure of the Tanmatras and the Paramanus was a fascinating one to these ancient thinkers, and a wide divergence of views prevailed. I will here notice several typical views:—those of the Vishnu Purána, Parásara, Patañjali and a certain School of Vedantists reported in the authung.

 A famous passage in the Vishnu Purána explains the genesis and the structure of the Tanmátras and of the Bhútas (Paramánus) in the following manner:—

The first Tanmatra originated from the rudiment-matter (Bhútádi), the individuated but still indeterminate potential-less Mass in Prakriti under the action of Energy ( उपस्थात: परिवासक्ति—कावनसम्ब, Sutra 66, Ch. I.) by a process of disintegration and emanation (विद्यांग:—विद्युपाण—काविकाराष्ट्र:—कावस्त्रक्त, Sutra 14. Pada IV. विद्युषाण—क्षित्रकावस्त्रक्षो व्यक्तिकावस्त्रके यानन, योगवार्शिक on Patanjali's Sutra.—सनीप्रकित' विकरणभाव: etc.) in the menstruum, or surrounding medium of the unindividuated Cosmic Mass (Mahat) ( सहताइत: ).

This first subtile matter, the first result of 'Mass disintegration' and Energy-transformation, is charged with the sound-potential, the potential of vibration or oscillation ( परिचन ). It is called the sound-potential ( गन्दनमात )

This is typical of the genesis (and structure) of the other Tanmitras (kinds of subtile matter). In each of the remaining cases, an atomic Mass charged with actual specific energies ( भ्रवपरमाण ) disintegrates and emanates, and thus evolves a form of subtile matter (a kind of Tanmátra) under the action of Energy, and always in the same menstruum or surrounding medium,-that Bhútádi, the super-subtile. Each kind of subtile matter becomes charged with a new potential in addition to the potentials already evolved. genesis of an atom, Bhúta Paramánu, is a quite different process. Here the unit potential (Tan matra) receives an accretion of Mass, and by a sort of condensation and collocation evolves an atom (Bhúta-Paramánu).

The genesis and structure of the Tanmátras and the Bhúta-Paramanus are worked out below:—

 The super-subtile individuated Mass (rudimentmatter (Bhútádi), under the action of the original Energy (रजः) disintegrates and emanates (विश्वयते) in the menstruum or surrounding medium (यसवर्ष) of Mahat, cosmic super-subtile Mass, and evolves a form of subtile matter (वसाव), which becomes charged with the sound-potential (vibration-potential, परिवाद), and is called the unit of sound-potential (वस्तवसाव).

- 2. This subtile matter, the Mass, charged with sound-potential, receives an accretion of Mass from the rudiment matter (Bhútádi) and by condensation and collocation evolves the A'kása Bhúta, the atomic A'kása, the proto-atom charged with the specific energy of the sound stimulus (actual vibratory motion.) ( य एव स्तर्गद शब्द-तकावान सर्वितीयान सद्युषकम् पाकाश स्थले। तथा च पददारबद्धकमानाथा विश्वता पाकाश स्थले, —वीगवार्षिक on the Vishnu Purána passage, Sutra 14, Pada IV).
- 3. This proto-atom, the atomic A'kása, charged with its actual specific energy, again disintegrates and emanates, under the action of the original Energy, and in the menstruum of the rudiment-matter (supersubti'e Mass) and thus evolves another kind of subtile matter; (Tanmatra) which becomes charged with the touch-potential (the potential of impact or mechanical pressure

- (भ्यानित, वहन्त्रीकत) in addition to the soundpotential (vibration-potential—परिखन्द) and is called the unit of touch-potential (खन्नतन्त्राच).
- 4. Next, this subtile matter, the mass charged with touch (and sound) potential, i.e., with the potentials of vibration and impact, receives an accretion of mass again from the rudiment-matter (Bhútádi) and by condensation and collocation, evolves the Váyu Bhúta, a kind of gaseous matter or air of which the atoms are charged with the actual specific energy of the touch stimulus, i.e., with actual energy of vibratory motion.
- Next, the atom of Vayu, so charged with the actual specific energy of impact and vibration, again disintegrates and nates, under the action of the original Energy, and in the same menstruum or surrounding medium of the rudiment matter ( super-subtile Mass-Bhùtádi) and thus evolves another kind of subtile matter (Tanmátra), which becomes charged with the heat-potential ( ) wir-wi-heat-andlight-potential; in addition to the impactpotential and the vibration-potential, and the unit of colour-potential is called (क्पतन्याच).

- B. Now this subtile matter. this radiant matter, charged with light and heat-potential, and also with impact and vibrationpotential, receives an accretion of Mass again from the rudiment-matter (Bhútádi) and by condensation and collocation evolves the Tejas Bhuta, the light-and-heatcorpusele, which is charged with the specific Energy of the colour-stimulus, i.e., radiates actual heat and light (fafacu in addition to manifesting the energy of impact (impingency) and of vibration (or oscillation),
- 7. Next, this atom or light-and-heat-corpuscle disintegrates, and emanates as before a form of subtile matter charged with the taste-potential (रहतनार). in addition to the three potentials already generated, and also with the physical potential of viscous attraction.
- 8. This subtile matter charged with the faste-potential and with the potential of viscous attraction condenses and collocates as before into the water-atom which manifests the actual specific energies of viscous attraction and the taste-stimulus.
- The viscous water-atom charged with the actual specific Energy of the taste stimulus disintegrates, and emanates as before a form of subtile matter charged with the

smell-potential in addition to the four potentials already generated and also with the potential of cohesive attraction.

10. This subtile matter charged with the smell-potential and with the potential of cohesive attraction condenses and collocates as before into the earth-atom, which manifests the actual specific Energies of cohesive attraction and the smell-stimulus.

Vijnana bhikshu in the Yoga-Vartika briefly summarises the Vishnu Purana process as follows:

Bhútádi as radicle in conjunction with Mahat produces the sound potential, which as radicle in conjunction with Bhútádi produces A'kása, which as radicle in conjunction with Bhútádi produces the touch potential, which as radicle in conjunction with Bhútádi produces Váyu, which as radicle in conjunction with Bhútádi produces the colour-potential, which as radicle in conjunction with Bhútádi produces Tejas and so on.

In this brief summary he does not bring out the force of चित्रवाष: (the disintegrating process), and the distinction between the genesis of subtile and gross matter (Tanmátra and Bhúta).

वया प्रधानेन महान्, महता स तवाहत:। भूतादिस्तु विकुर्व्याय: समै तन्माचिकं तत:। ससर्वं शब्दरुकातात् भाकाशं शब्दलवयम् । शब्दमानं तदाकाशं भूतादिः स समाहयोत् । भाकाशस्तु विकुर्व्यायः सर्वमानं ससर्वं द । वस्त्राम् भभवत् वादः तस्य स्वर्शे गुर्वा सतः । (विद्युद्वराय)

11. A famous passage in Parásara takes another view of the genesis and structure of the Tanmátras and the Bhúta-Paramásus. Krishna-pada, in the वस्त्रवर्णन्त्रमण, represents the scheme as follows:—

The Tanmatras originate from one another in one linear series, and each Bhúta originates in a separate line from its own Tanmatra.—

भुसादि (Bhútádi)

Sound-Tanmátra—as a radicle or centre surrounded or encircled by Bhútádi generates A'kása.

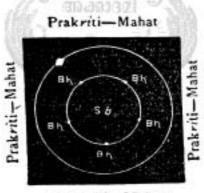
स्रमेहन्याव Touch-Tanmátra—as a radicle or centre encircled by Sound-Tanmátra with A'kása-atom as a help generates Váyu—

द्वतसात Colour-Tanmátra—as a radicle or centre encircled by Touch-Tanmátra with Váyu-atom as a help generates Tejas—

Taste-Tanmátra—as a radicle or centre encircled by Colour-Tanmátra with Tejas-atom as a help generates Ap—

नव्यवद्यात Smell Tanmatra—as a radicle or centre encircled by Teste-Tanmatra with Ap-atam se a helpgenerates Prithivi. The genesis of a Bhúta-Paramanu (atom) from the subtile matter of a Tanmatra is not here so simple as in the view of the Vishnu Purana. The latter speaks of condensation and collocation, but in the passage under reference a Tanmatra is supposed to act as a radicle, as the centre of a system, surrounded or encircled by Tanmatras of the immediately higher order in the medium of its own Bhúta.

Thus an atom of A'kasa has the following structure:



Prakriti-Mahat

An atom of A'kasa

Sb=S'abda-Tanmátra (vibration-potential)

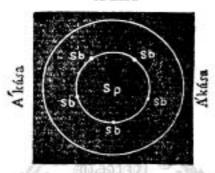
Bh = (Bhútadi)

7

An atom of Vayu is constituted as follows:—

This takes place within the surrounding medium of A'kasa.





A kása

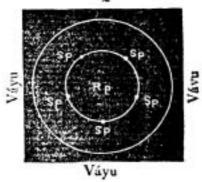
## An atom of Váyu

Sp = Sparsa-Tanmatra (impact-potential)

Sb = S'abda-Tanmátra (vibration-potential)

An atom of Tejas-heat-and-light corpusclehas the following structure :-

## Váya



## An atom of Tejas

Rp = Rúpa-Tanmátra (light-potential)

Sp = Sparsa-Tanmatra (impact-potential) and so on.

A Chemist will be disposed to push his chemical processes into the region of subtile matter. He may translate with as a menstruum, and evice as a catalytic agent. In this case, an atom of Vayu will be considered as generated from the impact-Tanmatra as a radicle, in the menstruum of vibration-Tanmatra, with A'sasa-atoms as a catalytic agent.

भवायं क्रम:— भृतादै: यन्दतन्त्रावं जायते, यन्दतन्त्रावं भृतादिराष्ट्रणीति , तत भाकाशं जायते, रातः भन्धात् श्रन्दतन्त्राचात् स्वर्धतन्त्रावं जायते, स्वर्शन्तन्त्राचं श्रन्दतन्त्रावमाश्चर्योति, एवं श्रन्दतन्त्रावाहतात् भाकाश्चरप्रथात् स्वर्धतन्त्रावात् वायुजीयते, ततः भन्धात् स्वर्धतन्त्रावात् व्यवन्त्रावं जायते स्वतन्त्राचं स्वर्धतन्त्रावमाश्चर्योति, एवं स्वर्धतन्त्राचाहतात् वायुच्छायकात् स्वतन्त्रावात् तेशी जायते—and so on. भयं क्रम: तत्त्ववविवर्धं स्थापादेशकः। वरवरमुनि, तत्त्रवयभाष्य (भिष्यकर्ष).

A slight variation of the above view is ascribed to a certain school of Vedántists in the त्यानिकाय.

The scheme may be represented as follows:-

A Bhuta-atom is evolved by integration (condensation and collocation, ভ্ৰাৰভাৱৰ) from the corresponding Tanmatra (subtile matter). This is the same view as that of the Vishnu purana.

The Tanmatras again evolve from one another in a lineal series as in Parasara's view. But the process of this generation is somewhat more complex. A Tanmatra first disintegrates and emanates in a surrounding medium (a menstruum) of the Tanmatra just preceding it in the order of genesis and with the help of its own Sthula Bhuta as a sort of catalytic, generates the Tanmatra next in order: e.g., the infra-atomic impact particles (winders) disintegrate or emanate, in a surrounding 'atmosphere' of the vibratory subtile matter (negrous) and then with the help of their own atomic integration Vayu, gas, generate the Tanmatra next in order, the subtile matter of radiant light-and-heat (3m:).

- III. Patañjali's view, as expounded in the व्यासभाष and बीगवार्त्तिक is as follows:—
- (a) The order of genesis of various forms of subtile matter (potentials) :—
  - Bhútádí, the rudiment-matter, original Mass, acted on by Rajas, Energy, produces the sound-potential (vibration-potential) पन्धा-नाधास् पद्यासमा स्वत्राध्यक्षमने राजसादद्वारः सदकारी सर्वति ।
  - (2) This subtile vibration-potential, as a radi-

- (Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtile touch-potential (impact-potential) which is impingent as well as vibratory (oscillating).
- (3) This subtile impact-potential again, as a radicle, with accretion of rudiment-matter (Bhútáid) condensing and collocating, and acted on by Rajas, generates the subtile light-and-heat potential (इपतकात) which radiates light-and-heat, in addition to being impingent and vibratory.
- (4) Next, the light-and-heat potential, as a radicle, with accretion of rudiment-matter, (Bhútádi) condensing and collocating as before, generates the subtile taste-potential, which is charged with the potential of the taste-energy, and of viscous attraction, in addition to being vibratory, impingent and radiant.
- (5) Lastly, the subtile taste potential as a radicle, with accretion of rudiment-matter as before, condensing and collocating, generates the subtile smell-potential, which is charged with the potential of the smellenergy, and also of cohesive attraction, in addition to being vibratory, impingent and radiant.

The order of genesis of the Bhúta Paramanus (forms of atomic matter).

The five classes of atoms are generated as follows:—

- The sound-potential, subtile matter, with accretion of rudiment-matter (Bhútádi) generates the A'kása-atom.
- (2) The touch-potentials combine with the vibratory particles (sound-potential) to generate the Vayu-atom.
- (3) The light-and-heat potentials combine with touch-potentials and sound-potentials (i.e. with impact particles and vibratory particles) to produce the Tejas-atom.
- (4) The taste-potentials combine with lightand-heat potentials, touch-potentials and sound-potentials (i.e. with radiant, impingent and vibratory particles) to generate the Ap-atom and
- (5) The smell-potentials combine with the preceding potentials (i.e. with particles of taste-energy and with radiant, impingent and vibratory particles) to generate the earth-atom.

The A'kasa-atom possesses penetrability, the Vayu-atom impact or mechanical pressure, the Tejas-atom, radiant heat-and light, the Ap-atom, viscous attraction, and the Earth-atom, cohesive attraction.

Vijūána-bhikshu in one passage gives the following scheme of the genesis of the Bhútas :-

A radicle of sound-potential with rudimentmatter gives A'kása-atom (Bhútádi), a radicle of touch-potential with A'kása-atom gives Váyu-atom, a radicle of light-and-heat potential with Váyuatom gives Tejas-atom, a radicle of tastepotential with Tejas-atom gives Ap-atom, and a radicle of smell-potentials with Ap-atom gives Earth atom. On this view, an atom

where  $Bh = \mu anf \epsilon$ ,  $Sb = \pi a\epsilon a \pi a$ ,  $Sp = \pi a a \pi a a$ ,  $Rp = \epsilon a \pi a a$ , and so on.

Bhútas and Paramanus—Cosmo-genesis and its successive stages.

The 'five Bhútas' stand for a classification of substances on the basis of their generic properties resulting, as the Sánkhyas hold, from the structural type of their constituent atoms—a classification more physical than chemical, or properly speaking chemico-physical, unlike the purely chemical classification of the so-called elements of modern chemistry. A Paramanu, again, is a type of atoms corresponding to each Bhúta class, and indeed one and the same kind of Paramanu may comprehend atoms

of different masses, if only these should agree in their structural type.

Cosmo-genesis-a bird's eve view :- Out of the all-pervasive rudiment-matter (Bhútádi) appeared A'kasa (ether), first as a Tanmatra (subtile matter) charged with the potential energy of sound (vibration-potential), and then as an atomic integration of a mono-Tanmátric structure (the Akása-atom — पाकामाप ) also ubiquitous and all-enveloping. the next stage we find a new kind of Tanmatras, systems of the infra-atomic vibratory particles, so arranged as to manifest a new form of energy, that of impact or mechanical pressure and these Tanmátras ( अर्थतन्त्राचाचि ) combining with vibration-potentials ( A kasa Tanmatra ) produced a new kind of atom, the di-Tanmatrie Vayu-atom, which by aggregation formed a gaseous envelope composed of impinging (driving) vibratory particles (Váyu). Next appeared the third class of Tanmátras, infra-atomic systems of the impinging vibratory particles, which by their collocation developed a new form of Energy-the energy of radiant heat-and-light. These Tanmátras तन्यावाचि ) combining with the potentials (Tanmatras) of vibration and impact, produced a new kind of atom -- the tri-Tanmatric Tejas-atom, the light-and-heat corpuscle, which by aggregation enveloped the gaseous world in huge flames. In the next stage we have the fourth class of

Tanmatras, new and complex infra-atomic systems the radiant impinging vibratory particles, which evolved the energy of viscous attraction as well as the potential Energy concerned in the taste-stimulas. These Tanmátras ( रसतनावाणि ) combining with the three previous ones, gave rise to another class of atoms, the tetra-Tanmatric Ap-atom, and the flaming gases were thus precipitated into cosmic masses of viscous fluid matters (Ap). Finally appeared the fifth class of Tanmatras infra-atomic systems of the viscous radiant impinging vibratory particles which developed new of Energy-the Energy of cohesive forms attraction, as well as the potential energy concerned in the stimulus of smell. These Tanmatras ( जनवादावा ) uniting with the other four kinds or infra-atomic subtile particles, formed another class of atoms, the penta-Tanmatric Earth-atom. Thus the viscous fluid matters were condensed and transformed into the Earth-Bhuta, comprising the majority of the so-called elements of chemistry.

The Puranas, in their own fanciful way, conceive that, in the course of cosmic evolution, each succeeding Bhuta appeared within an outer envelope of its immediate predecessor, with a total mass (or volume?) a tenth less than that of the latter. वियत् ततायेकदेशयती वायुः प्रकल्पितः । चिक्रयेत् विज्ञमध्येतं सदती स्पृतवर्षानं ॥ ज्ञान्त्रावरचेष्यं यां सूत्राधिक-विचारचा । वायोर्दशांगतो सूत्री विज्ञांगी प्रकल्पितः ॥ पुराचीतं तारतस्यं दशांगेर्भृतपञ्चते ॥

(पश्रदशी-सृतविवेक, slokas 72, 81 and 82)

#### Examples of the different Bhútas :-

- A'kása :- This is ubiquitous.
- 2. Váyu:—Various substances composed of di-Tanmatric atoms,—kinds of Váyu—must have been formed in the gaseous envelope in the second stage of cosmic evolution, out of the proto-atoms of A'kása. But they have either suffered a fresh transformation into substances of a more complex atomic structure, or have dissipated into the mono-Tanmatric A'kása, out of which they took their rise. The one familiar example now surviving is atmospheric air. Water-vapour (आप) is but water (Ap), and smoke, fumes, etc. but earthparticles in gaseous diffusion.
- Tejas .— Various classes of Tejas corpuscles,—substances with tri-Taumátric atomic structure, i.e. two grades subtler

than the ordinary elements of chemistry (which are of a penta-Tanmatric structure),—are even now known. (तेजो भीनादि-भेदेन वहुविष'। भीनं दिव्य' भीदके भाकरचं— वरवरमनि,—तत्त्ववयभाष्य)।

First, there is fire, or the light-and-heat emitted by the burning log of wood or lamp ( पांप:-दोप:-भी सं तेल: ). Now it is important to note that the flame of a burning log of wood ( \*\*\* ) or an oflamp is not pure Tejas, a pure mass of light-andheat corpuscles. There is chemical union with Earth-particles (particles of the hard penta-Tanmatric substance) acted on by Energy; and then the Tejas corpuscles, light-and-heat particles which are latent (absorbed) therein, come forth as flame (पार्षिकीपष्टकोन तदनुगतात तेजस: विज्ञानिभिच-प्रवचनभाष्य, Sútra 110. Chap. V). Then there is the light of the sun and the stars (दिन्न' सोरं पादिलादि ) which are flaming masses of molten viscous matters (जलमाहेसमें तेज: दिया तव ऋचित्रकरण) or of molten मुर्खादि.—तत्त्ववयभाषा, earthy matters स्वांदीनि स्वांचि तैनांसि पार्धिवहना-स्ट्रेनैंव चवस्थितानि,-दिशानिभच्, प्रवचनभाष, Sutra 13, Chap, III). There is also the lightning, which liberates a kind of Tejas latent in the aqueous particles and vapours, under the action of

Energy, in the same way as an ordinary fire liberates the Tejas latent in the wood or other fuel. Next there are the stores of animal heat derived from the break-up of the nutritive material ( चीद्धे ). Lastly there comes the peculiar form of the Tejas Energy (radiant Energy) stored up in the metalliferous ores and igneous rocks which have been formed in the subterranean heat. Here Earthy matters are mixed up, but the radiant Energy predominates in the composition of the metals (तैजपाधिकोन तैजसादिता संबर्धादीन!—विज्ञान-विषय, प्रवचनशाय, Sútra 19, Chap. III). Aniruddha, a late Sánkhya commentator, notes in reference to 'igneous bodies' that the greater part of their mass is derived from the Earth-Bhûta, though the Tejas particles determine the peculiar chemical combination, which produces them; and this must also be his view of the composition of the metals. सच चित्र (तेजनी प्रशीर चित्र ) वहतरपार्थिवावसवावष्टवाकल', चलाले चानुवभीवात् । ( चनिक्दविच-Sútra 112, Chap. V. )

4. Ap. This viscous fluid of a tetra-Tanmatric structure has but one pure example, viz., water, though the various organic acids, the juices of fruits and the saps of plants, are supposed to be transformations of watery radicles combined with different kinds of earthy accretions.  Lastly the Earth-Bhûta, the hard fullformed matter, with its penta-Tanmatric atoms, comprises by far the majority of the so-called chemical elements.

The question is,—how does one and the same Bhûta, of the same formal structure, comprise different kinds of elements, with different atomic masses, and different characteristic properties? And the answer is not far to seek. The properties of a thing are only the energies that are manifested in the particular collocations of the three Guzas,—Mass, Energy and Essence; and a tri-Tanmátric, or a penta-Tanmátric atom, i. e. an atom composed of three or of five kinds of Tanmátras may differ from another of the same class, in respect of the number of constituent Tanmátras of any particular kind, as also of their collocation or grouping, and therefore in mass as well as in generic and specific characters.

The Sankhya-Patanjala conceives the properties (or energies) of substances to result from the grouping or the quanta of the Tanmatras, or the Gunas themselves, and hence any radical differences in substances of the same Bhuta class must characterise their atoms, though in an infrasensible form. In the Nyáya-Vaiseehika, on the other hand, the atoms of the same Bhuta class are alike in themselves, homogeneous; and the variety of substances comprehended under the same Bhuta, is ascribed merely to the different arrangements or groupings of the atoms ( भूक ) and not of their components, for components they have none.

As a typical and familiar instance of the variety of characteristic properties (or energies) that may result from variations in accompaniment or grouping, the Sankhya-Patanjala points to the various kinds of fruit acids and juices, all originating from one and the same Bhuta (water) with different accretions of earthy matters ( म्रावकाराः ). In the same way, though we speak of only five classes of Tanmátras and atoms, the infinite variety of the world results from the infinitely varied collocations of the three original Gunas, which underlie Tanand atom alike (सल्दलसन्स प्रवर्धकाष्ट्रापत्र: परमाणरिति-नायवासिक, खबीतकर, reporting संघात: the Sankhya view : चयुतिसहावयव: संघात: परमाणरिति-व्यासभाष, Sutra 44. Pada III .- प्रमान: सामानविश्याका चयुत्तविद्वानयवभेदानुगतः समुदाय,-व्यासभाष्य, Sútra 44. IV -- शोम्बताविकता धर्मिय: Pada क कि रेव भया: (ibid., Satra 14, Pada III.) यी धर्मांत्र पत्रपाली सामान्य-विशेशाया सीइनयी धर्मी (ibid., Satra 14. Pada III ).

आदितत—कथं एकद्वपाची गुणानी घनेकद्वा प्रकृतिः— इत्यत चाड परिणासतः सलिकवत्। यथा वारिद्विसुकं सदकं एकरसं चिप तक्ष्युविकारान् चासाय नारिक्ष्य-ताली-विल- चिरिवल-तिन्दुकामणक-कपित्यप्रवरस्तया परिचामात् सप्रश्यास्यय-तिज्ञकटुकपायतया विकल्पते, एवमिकैकगुणसम्बन्धतात् प्रधानं गुणम् वाधित्य व्यवधानगुणाः परिचामभेदान् प्रवर्णयन्ति । तदिदमुकं प्रतिप्रतिगुणायय-विशेषात्, एकैकगुणाययेण यो विशेषसम्बन्धात् द्रव्ययः ।

## ( वाषस्पति-कौमुदी-On Káriká 16. )

If we take a unit of rudiment-matter (Bhûtádi) for the unit of mass (cf. the mass of an electron with a charge of motion etc.), and represent the first Tanmátra by  $t_1$  such units, and if further,  $t_2$ ,  $t_3$ ,  $t_4$ ,  $t_5$  units of mass (Bhûtádi) be successively added at each accretion to form a fresh Tanmátra, then the second, third, fourth and fifth Tanmátras will respectively contain  $t_1+t_2$ ,  $t_1+t_2+t_3$ ,  $t_1+t_4+t_5$ , and  $t_1+t_2+t_5+t_5+t_5$  units of mass.

Also the Vâyu atom (bi-Tanmátric system) will contain  $t_1+(t_1+t_2)$ , i.e.  $2t_1+t_3$  units of mass; the Tejas-atom (tri-Tanmátric system) will contain  $t_1+(t_1+t_2)+(t_1+t_2+t_3)$  i.e.  $3t_1+2t_2+t_3$  units; the Ap-atom (tetra-Tanmátric system)  $t_1+(t_1+t_2)+(t_1+t_2+t_3)+(t_1+t_2+t_3+t_4)$ , i.e.  $4t_1+3t_2+2t_3+t_4$  units; and the Earth-atom (penta-Tanmátric system),  $t_1+(t_1+t_2)+\dots+(t_1+t_2+t_3+t_4)+\dots+(t_1+t_2+t_3+t_4)+\dots+(t_1+t_2+t_3+t_4+t_5)$ , i.e.  $5t_1+4t_2+3t_3+2t_4+t_5$  units.

If t units of mass be added to the first Tanmatra to form the atom of A'kasa, the latter will contain t, +t units of mass. In other words the numbers representing the mass-units (Tamas) in the different classes of atoms (gross matter) will form an ascending series, viz.  $t_1+t$ ,  $2t_1+t_2$ ,  $3t_1+2t_2+t_3$ ,  $4t_1+3t_2+2t_3+t_4$ , and  $5t_1+4t_2+3t_3+2t_4+t_5$ .

Now if a follower of the Sankhya-Patanjala were asked to account for differences among Paramanus of the same Bhúta class, he would perhaps suppose  $t_1$  to vary from  $\prec_1$  to  $\beta_1$ ,  $t_2$  from  $\prec_2$  to  $\beta_2$ ,  $t_3$  from  $\prec_3$  to  $\beta_3$ ,  $t_4$  from  $\prec_4$  to  $\beta_4$  and  $t_5$  from  $\prec_6$  to  $\beta_5$ .

Therefore the mass-units contained in the Váyuatoms of the different possible Váyu substances
would be represented by 2 < 1 + t, in A. P. with unity as common
difference, there being  $2(\beta_1 - < 1) + 1$  possible Váyu
substances,

The mass-units contained in the Tejas-atoms of the different possible Tejas substances would be represented by the series,  $3 <_3 + 2 <_z + <_z$ ,  $3 <_1 + 2 <_z + <_3 + 1$ ,...... $3\rho_1 + 2\rho_2 + \rho_3$ , increasing in A. P. by unity as common difference, then being  $3(\rho_1 - <_3) + 2(\rho_2 - <_z) + (\rho_1 - <_3) + 1$ , Tejas substances possible.

The mass-units contained in the Ap-atoms of the different possible Ap-substances would form the series 4 < 1 + 3 < 1 + 2 < 1 + 3 < 1 + 3 < 1 + 2 < 1 + 3 < 1 + 3 < 1 + 2 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1 + 3 < 1

The mass units contained in the Earth-atoms of the different possible Earth-substances would form the series in A. P.,  $5\times_1 + 4\times_2 + 3\times_3 + 2\times_4 + \times_5$ ,  $5\times_1 + 4\times_2 + 3\times_3 + 2\times_4 + \times_5 + 1, \dots, 5\beta_1 + 4\beta_1 + 3\beta_3 + 2\beta_4 + \beta_4$ , there being  $5(\beta_1 - \chi_1) + 4(\beta_2 - \chi_2) + 3(\beta_3 - \chi_3) + 2(\beta_4 - \chi_4) + (\beta_5 - \chi_5) + 1$  Earth-substances possible.

Size (परिमाण).—As to size or vulume, the Sankhya accepts only two kinds,—the infinitesimal, which is also without parts ( पण्—निर्मण ) and the non infinitesimal, which consists of parts (मण्यू— सम्बद्ध ). The latter varies from the excessively small (the so-called Anus. Tanmatras and Paramanus) to the indefinitely great ( परममण्यू—विमृ.—e.g.—A'kasa ).

The Gunas alone are infinitesimal, with the exception of those ubiquitous ones that evolve into A'kasa-atoms and Mind-stuff ( भाकामणु and भक:-भरण):—all the rest of the evolved products (whether subtile or gross matter) are non-infinitesimal.

Vijnanabhikshu notes that all the Gunas (Reals) cannot be ubiquitous. If this were the case, that disturbance of equilibrium, that unequal aggregation with unequal stress and strain, with which cosmic evolution begins, would be impossible. The Gunas, which give rise to A'kasa and Mind-stuff, must be held to be ubiquitous, and this will suffice for the ubiquity of Prakriti.

(म च चलाइयंने गुवास्थ्यक्षतः विश्वतम्यात् रति वाचन्। चनः करवाकायदेतुगुवानां विश्वति तदुपवतः। सर्वगुवानां विश्वति स्रति चाद्यपरिवानदेतुचीमसंबीगाद्यसंभवात् (बीनवार्षक, Sútra 51, Pada III.)

Chemical analysis and Synthesis—Elements and Compounds.

What then is the equivalent in the Sankhya-Patanjala of the distinction between a chemical element and a chemical compound, or is there none? Did or did not this elaborate physical analysis and classification of things lead on to a classification based on chemical analysis and chemical synthesis? These are questions of singular interest, the answer to which will disclose some new points of view from which the ancient Hindu thinkers approached the problems of chemical physics and physical chemistry.

Aggregates (सम्भा:) may, in regard to their structure, be divided into two classes, (1) those of which the parts are in intimate union and fusion, being lost in the whole ( चयुनस्थानस्थाः समुद्राः ); and (2) mechanical aggregates, or collocations of distinct and independent parts (युनस्थानस्थाः समुद्राः).

A substance is an aggregate of the former kind, and may be divided into two classes, (1) the Bhútas and their 'isomeric' modifications भूत, मृतभेद and भूतिकार); and (2) chemical compounds (भिश्विदस्थ,

इंद्रबाहर ). Chemical compounds again may be subdivided into two classes, (1) those composed of atoms of the same Bhuta class, i.e. of different isomeric modifications of the same Bhuta, and (2) those composed of atoms of different Bhúta classes. In the first case, there is contact between 'isomeric' atoms (सनानीय-संबीत), in the second case, between heterogeneous or 'polymeric'? atoms ( विजातीय-संयोग ). The first contact leads to intimate union (सह:-सङ्ख्यः यः संयोगविशेषः तेनैव सर्वति-विज्ञानभिष व्यवनमाय): the टब्बायां विकारी isomeric atoms by a peculiar liberation of Energy ( सनातीयोपस्थ—the action of similars on similars ) are attracted towards one another, and being riveted as it were, form the so-called material cause (खपादान कारक) of the compound product. The second kind of contact (that between unlike or 'polymeric' ? atoms of heterogeneous Bhútas ) begins with a liberation of Energy ( वपस्य ), which breaks up each of the Bhútas, and taking particles (or atoms ) of one as nuclei or radicles groups particles of the rest round these radicles in a comparatively free or unattached condition. In this case, one Bhuta, that which serves to furnish the radicles, not necessarily that which is numerically or quantitatively predominant, gets the name of material cause ( उपादानकारक ), and the others, which by their collocation cause the liberation of Energy ( चपटक, प्रक्ष or विषक ).

are called efficient causes (किसिस कारण)—एकमिनैकगुण्यस्थात् व्यान गुण्यसिख चन्नधानगुणः परिणामभेदान्
प्रवर्त्त्वि—वाचस्रति, कीमुदी on Kárika 16. The illustration given (viz. the Rasas as modifications of
Ap, water, with Earth-accretions) show that this
process applies not only to the Gunas, but also to
the Bhútas. यथा चानाभादिकरचं चिनलं पतितं नानादपान्
संग्रेषान् भियते—(गीडपाद on Káriká 17).—तम चिप (तेजसे
ग्रेशीर चिप) वहतरपार्विवावययावस्थात् चलले च चनुपभीगान् (चनिद्दद्व on Sátra 112, Chap. V), जातिसाद्वर्कस्य चलाकमदीयतान्
सामग्रीसम्बद्धाने चनेकरिप इन्द्रिये: एकदा एकहत्त्वृत्पादने वाधकं नास्मि
(दिशानसिण्—प्रवचनभाष्य),

Aniruddha goes so far as to hold that both 'isomeric' and 'polymeric' (or 'heterogenic') combinations are real cases of constitutive contact, ( बारक्षकसंग्रीन, e.g. भौतिकवायी दें हारक्षकत्म— विनद्ध on Sútra 113, Chap. V.) But in the later Sánkhya-Pátañjala the current teaching denied this— बद्धनामुपादानायीगात (Sútra 102, Chap V), when विद्यानिक्ष notes— बद्धनां भित्रजातीयानां वीपादानल' न दृष्टिनित सजातीयमेवीपादानम्। इतरक स्वचनुष्ट्यम्पष्टक्षकम्।

But besides these transformations of substance ( इच्यान्तर-परिषास ) by 'isomeric' or 'heterogenic' process, ceaseless changes go on in the characters, the modality, and the states of substances—changes which are due to the unequal distribution of force (or of stress and strain,—pressure) among the Gunas, which are in themselves constant. ( पर्य- स्थापकापरियामा: न द्रव्यानरत:,—यथा एका रिक्षा प्रतस्त्राने प्रतं द्रव्याने दर्ग. एकधेकस्त्राने, द्रवा चैकलेऽपि स्त्री माता घोष्णते दृष्टिता च समा चित,—गुणिनसलेऽपि गुणाना दिसदंवेषियात्—स्थासभाष, Sútra 13, Pada III.)

"Even as the same figure '1' stands for a hundred in the place of hundred, for ten in the place of ten, and for a unit in the place of unit."

~03 MJ-02~

\* This conclusively proves that the decimal notation was familiar to the Hindus when the Vyass-Bhashya was written, i.e. centuries before the first appearance of the notation in the writings of the Arabs or the Greco-Syrian intermediaties. Váchaspati, who comments on the Vyása-Bháshya, composed his Nyáya-Súchi-Nibandha in ugaqquagt i.e. Samvat 898 or 842 A. D. This cannot be S'aka 898, for apart from the decisive use of apart, which by this time had come to signify the Samvat era, Váchaspati's commentator Udayana, wrote the Lakshauávalí in S'aka 906—

# तकांस्वराद्धशमितेष्वतीतेषु प्रकाशतः। वर्षेष्ट्यमदके सुवीधां लचकावलीम् ॥

and Udayana, who wrote the Parisuddhi on the Tátparyyatíká of Váchaspati, could not have been a contemporary of the latter, as will also appear from the invocation to Sarasvati in the opening lines of the Parisuddhi. Váchaspati then preceded Udayana by 142 years, and must have been himself preceded by the author of the Vyása-Bháshya by a

Now the question is-in these mixed substances does the fusion take place by Paramanus or by larger masses (or lumps) ? Now a Paramánu is defined to be the smallest portion of any substance which exhibits the characteristic qualities of that substance, -in other words, it stands for the smallest homogeneous portion of any substance. It is not without parts and therefore not indivisible. It is subject to disintegration. In a Bhuta or its isomeric modification, the Paraminu, the smallest homogeneous component particle, is unmixed, and therefore corresponds to the atom of modern chemistry. In a mixed substance ( fafeaza, संस्त्रभुताये ) whether it is an 'isomeric' or a 'polymeric' compound, the qualities are due to the mixture. and therefore its Paramanu, the smallest homogeneous particle possessing its characteristic qualities, must result from the mixture of the Paramanus (in smaller or larger numbers as the case may be) of the component substances. The Para-

longer interval still, for Vachaspati ascribes the Bhashya to Veda-Vyása himself ( क्रामित भाषि भाषी आद्या विवाहती). The internal evidence also points to the conclusion that the Bhashya cannot have been composed later than the sixth century,—ef. the quotations from Pañchasikha, Várshaganya, and the Shashfi-Tantra-S'ástra, without a single reference to I'svara-Krishua—which is decisive. I may add that I remember to have come across passages of a similar import in Buddhist and other writings of a still earlier date.

manu of a mixed substance therefore corresponds to what we now call molecule. ( चपकर्षपर्यानं दर्श परमाण्दिति-व्यासभाषा । लीड्स हि प्रविभव्यमानस्य यक्तिद्ववयवे प्रत्यत-तारतमां व्यवतिष्ठते सः चयक्षपर्यन्तपरमाषः --वाचस्यति --तस्ववैद्यारहो --Sútra 52, Pada III. - नाण्यित्वता न निर्भागतः । पृथिवीपरमाणः जलपरमास्रिकादिव्यवद्वारल् पृथिव्यादीनामपकर्षकान्तामिप्राधिषेत। विज्ञान-क्षिण,—ववचनभाष्य, Sútra 88, Chap. V.)-That the Paramanus form molecules ( 1974 ) in forming substances, is acknowledged by the Sankhyas as will appear from Gaudapada, - तथा चनो काषयाय राण्कवद्गुणाः । ( कोइपाद, on Karika 12). Even the Vaiseshikas, with their prejudice against 'polymeric' or 'heterogenic' combination, acknowledge that in 'polymeric' compounds the different Bhuta substances unite by their Paramanus (or atoms), though they rigidly insist that in such cases only one atom should be regarded as the 'radicle' ( जपादान or दब्बारक्षककारक) others as co-efficient causes ( निमित्तकारय-चपटकाक ), e g. श्रमलाद-एवं समृत्यद्वेष चतुर्धं महाभूतेषु महेवरसाभिध्यानमा-यात् तैलसिम्बोद्रवृथ्यः पार्थिवपरमाय्यक्तिम्बी मध्यकः मुन्यकते (प्रश्रकः पादमाख - where S'ridhara notes पार्थिवा अवयवा उपस्थाका: Udayana तेजसानां परमाण्नां पार्धिवास्माहित्वेन धिरकायलं विविचितं )।

It is only in the mediæval Sáňkhya-Pátañjala that under the influence of the Nyaya-Vaiseshika doctrine a radical difference was conceived to exist between the structure (or constitution) of a molecule composed of 'isomeric' atoms, and that of one composed of heterogeneous (or 'polymeric'?) atoms. In the former case, there was believed to take place intimate union ( चक्र ), in the latter case, only a grouping of comparatively free or loosely attached atoms round a radicle atom ( ATT), with liberation of Energy ( squa,-warm-or farm) and the setting up of unequal stress and strain ( न्यामेक्सविमई-ध्यारक्षण ). At the same time, it was of course admitted that this distinction does not apply to the forms of subtile matter ( Tanmatra-मुक्तमूत ) which could unite in intimate fusion, whether homogeneous or heterogeneous. For example, the subtile body ( मुख्यारीर ) which is supposed to be the seat or vehicle of the conscious principle is acknowledged by Vijnana-bhikshu to be penta-Bhautic ( दक्षमुतालक ) ; in other words, all the five Tanmatras serve as material causes, though the gross body (the animal organism ) is stated to be only a 'polymeric' compound with the Earth-Bhuta as radicle or base. पश्चिमागारीरं च गुणां पश्चमृताताकं बस्तती। तन्यावकार्ये यत् सूतपञ्चकं लिङ्गाधिष्ठानं घरीरम् ( प्रवत्रमाथ- Sútras 11 and 12, Chap. 1II.— खूलकरीर पार्थिटमेव घन्यानि च मृतानि उपचन्नकानि (ibid. Sútra 19, Chap. III.)

But in the original Sankhya-Patanjala it appears that the production of a new substance by mixture of unlike Bhutas (विश्वातीयसंयीन) was conceded as freely as in the Vedánta, and was conceived as nowise differing from the formation of a compound of atoms of the same Bhuta class. The Sánkhya analysis of all change into transformations of Energy due to collocations of unchanging Gunas, in other words, the prevailing chemico-physical ( or physical ) point of view, naturally recognises no distinction between collocations of 'isomeric' and those of heterogeneous (or 'polymeric' ?) atoms At bottom they are all collocations of the Gunas. Even Vijnanabhikshu who, as one of the latest expounders of the Sankhya-Patanjala, has been most affected by the Vaiseshika prejudice against 'polymeric' combination ( विजातीयसंधीय ) urges that the qualities of a compound substance are not necessarily the result of similar qualities in the component elements. (सन्तरीय-कारवगुणकोव कार्थ्ययुपारमा कता इति त तेवां (तार्विकाणां) प्राप न निवनः।) Elsewhere he explains that far from the vital activity being independent it is originated and maintained by the combined operation or fusion of the different sensory and motor reflexes of the living

organism, and notes that the united operation of mixed (or miscellaneous) causes, where there is a fit collocation of matter, offers no difficulty to a follower of the Sankhya-Patanjala :- ( जाविशाक्ष्यंश पक्षानमदी-बलात, सामगीसमन्याने सति वनेकर्राप द्रान्त्रवे: एकड्डा एकडक्कत-पाइने बाधकं नाजि-प्रवचनभाष्य, Sútra 32, Chap. II). In the middle of the ninth century, we find Vachaspati instancing some 'heterogenic' or 'polymeric' compositions as typical examples of evolutionary change ( परिवास ) and unhesitatingly accepting the substantive character of the products. In the Kaumudi he describes the various acids and juices of fruits as modifications of the same original water in the presence of different kinds of earthy accretions. The process is peculiar. The water-particle (or atom) serves as a radicle or centre of a system, and the different kinds of the Earth-Bhuta centering round this as a nucleus become the seat of forces, which bring in the development of new energies (and new qualities, e.g. tastes) in the water. यथा वारिदविमुक्तमृद्व एकरसमित तत्तदुः सर्तावकारः न वासाय नारिकेल-ताली-विल्ल-किरित्यादि-रसतया परिचामात् नध्रासलयचितकच्युक्षप्रायतया विकल्पते। इति एकेक्त्वसम्बद्धात प्रधानगुणम पारित्य पप्रधानगुणाः परिणामभेदान प्रवर्भवन्ति । (कीमुदी on Karika 16). Vachaspati also that different substances may be points out transformed into one and the same substance (e. g. the production of salt by the cow, the horse, the buffalo and the elephant, thrown into the salt factory of Sambara in Rajputana or of the flame of a candle by the combination of wick, oil and fire. (परिचामेकल' बहनामपि एक: परिचाम: हष्ट:। तह्यचा गवाऽय-महिचमाठकानां दमानिजितानां एकलक्पालनातीयलच्च: परिचाम:, विभिटेलानलानां च प्रदीप रति।—तस्त्रवैद्यारदी on स्वासभाष, Pada IV. Sútra 14.)

Earlier still, i.e., not later than the sixth century. the Vyasa-Bhashya, noting that inorganic matter, vegetable substances and animal substances do not differ from one another essentially in respect of their potential energies and ultimate constituents, points out that various bi-Bhautic chemical compounds of water and earth substances, in the shape of saps, acids and juices, are found in plants in their different parts (जलभूमी: पारिवादिकं रसादिवेयद्यां स्तावरेषु इष्टम् ). In other words, bi-Bhautic compounds are here placed in the same category as 'isomeric' compounds of substances of the same Bhuta class, for here the particles of both the Bhutas are regarded as forming the matter (material cause-खपादानकारण) of the smallest homogeneous portions of the compound substances.

N.B. -- Vachaspati naturally interprets this to mean separate modifications of the two Bhútas. The view of the earlier Sankhyas that atoms of different Bhútas may chemically combine to form molecules of compound substances as much as atoms of different modes of the same Bhúta comes out clearly in Utpala's brief reference to the Sankhya system in his commentary on Varahamihira's Vrihat Samhita. (एक: प्रथम [ तन्त्रातेम: ] प्रमाणामानि भवन्ति । तेम्ब: मरीरियां मरीराचि । यत: प्रमाणामानि मरीराचि । पराः प्रमाणामानि । पराः ।

Chemistry in the medical schools of ancient India :- As a matter of fact, long before the fifth century, probably as early as the first century A. D. the prevailing schools of medicine and surgery which were based on the S'ankhya teaching with a methodology derived from the Nyáya-Vaiseshika doctrine (cf. Charaka, S'árírasthána, Chap. I. Vimánasthána, Chap. VIII-also Susruta, Sarirasthana, Chap. 1) had founded an elaborate theory of inorganic and organic compounds, which equally admitted iso-Bhautic and hetero-Bhautic combinations. Like the Vedantists, Charaka held that each of the gross Bhútas (Mahábhútas) is a peculiar ultra-chemical compound of five original subtile Bhutas. In this sense, every substance is penta Bhautic, but for purposes of chemical analysis and synthesis, i. e. considered with reference to the Mahabhutas, all substances in their chemical constitution, belong to

one or other of the following classes: Mono-Bhautic, bi-Bhautic, tri-Bhautic, tetra-Bhautic, and penta-Bhautic. Compounds of different Bhūtas, again, may combine to form more complex substances, and these in their turn, higher compounds still, and so on in progressive transformation, as is more specially the case with organic substances and products.

Physical characters of the Bhûtas:— The prevailing physical characters of the different Bhûtas and their isomeric modes are enumerated as follows.

Earth-substances—Heavy, rough, bard, inert, dense, opaque, exciting the sense of smell.

Ap-substances—Liquid, viscous, cold, soft, slippery, fluid, exciting the sense of taste.

Tejas-substances—Hot, penetrative, subtle, light, dry, clear, rarefied, and, luminous.

Vayu-substances—Light, cold, dry, transparent, rare-fied, impingent,

A'kása-substances—Imponderable (or light), rarefied, elastic, capable of sound (vibrations).

( गुरुखरकठिनमन्द्रक्षिराविषदसान्द्र-स्यूचनसगुष्यदृत्तानि पार्थियानि । दवसिरधजीतमन्द्रसदुपिक्तिसस्यसम्बद्धानि पाष्पानि । स्वातीकास्कान सक्षरचिषद्रस्यगुणवद्गलानि पाष्पेयानि । समुजीतस्यस्यनिषद्श्यासर्थ- गुणवहतानि वाधव्यानि । सद्वत्रभृष्यश्चन्नश्चानि चाकाशास-कानि ।—Charaka, S'árfrasthána, Chap. 26; compare Susruta, Sútrasthána, Chap. 41).

Charaka points out that the primary qualities or specific physical characters of the five Bhūtas are tactile qualities, i. e. sensible to touch, e.g. hardness (or roughness) for Farth, liquidity (or yielding to pressure) for Ap, impelling or moving force (pressure) for Vayu, heat for Tejas, and Vacuum (non-resistance, penetrability) for Akasa.

(खरद्रवचतीचलं भूजनानिजतेजसास्,

भाकाशस्त्रापतीचाती उर्द सिद्ध धयाक्रमम्। सच्च सर्वमेवैतम् स्वर्धनेन्द्रियगीचरम्।

Charaka-S'arirasthána, Chap. I.)

(cf. the elaborate enumeration of physical characters quoted in Vijnana-bhikshu, Yoga-Vartika, Sutra 42, Pada I;—also Varavara's commentary on Tattva-traya Achit-prakarana).

The Mahá-Bhútas—mechanical mixtures:—
Susruta notes that each of the gross Bhútas (Mahábhútas) is found mixed up with the other Bhútas;
—e. g., the Mahábhúta A'kasa is the receptacle (or
vehicle) of air, heat-and-light, and water vapour;
the Mahábhúta Váyu, of water-vapour, light-and
heat, and even fine particles of Earth held in
suspension; the Mahábhúta Tejás, of earth-particles in the shape of smoke, and also water-vapour.

(चनोइन्यानुशिवद्यानि सन्त्रीनोतानि निर्दिशेत्—Susruta, S'arirasthána, Chap. I.) चन्ये पुन: चन्या व्याच्यते। चाकाश्च प्यन-दक्ष्य-तीयानि। वायौ तेलोइन्युनी। सूरिप चन्नताविशेषेष। स्निरिप धूर्माद्दपेष तेलसि। तेलीह्य्ये पानीयश्चि।—Dalvana on Susruta, loc. cit.)

Mono-Bhautic Earth-substances:—Charaka and Susruta regard the following as Earth-substances—Gold, the five Lohas (silver, copper, lead, iron and tin) and their 'rust', arsenic, orpiment, various mineral earths and salts sand, precious stones. (Charaka, Sútrasthána, Chap. I. Cf. also Susruta, Sútrasthána, Chap. I—पाविवा: सुरचंदलतमण्यमुखानन:- शिलायनकपाखादव:। सुरचंदल इंद पार्विवलमेनाक्वीक्रियने नुदलकादिक-संव्यादिक्विया:। मृते वादियक्यान् वीवमलिकतासुभावारताखलनय-वेदिकरसासन प्रश्तीन!—Dalvana on Susruta, loc. cit.)

The salts include common salt, saltpetre, etc. Susruta mentions, the alkalis, borax, natron, Yavakshara (carbonate of potash) etc. The Audbhida salt, an inflorescence of the soil, stands for reh ( चौदिरं पायलवर्ष बजातंभूमित: स्थम् ).

Of these Earth-substances, some were known to be compounds, e. g. the chemical salts of the metals, collyrium etc. Susruta describes the preparation of the metallic salts. The leaves of the metals were pasted over with the salts, and then roasted ( sussite) ( Chikitsásthána, Chap. 10 ). These metallic salts are therefore mono-Bhautic Earth-compounds, Susruta also gives the preparation of mild and caustic alkalis, (Sútrasthána, Chap. 11.

Origin of precious stones:—Some hazarded the guess that the precious stones are rocks (or earths) metamorphosed by natural process in the course of ages (Varáhamihira—देखिया प्राइद्यक्षानाम् केचिन् सुद: सभावान—Utpala notes,—रजद्यक्षे प्राप्ता: कालाक्ष्ट्रेष ).

Ap-substances, simple and compound :-

Susruta, following Charaka, enumerates various classes of Ap substances ( द्वाट्य) as follows:—waters, acids, milks, curds, butters, oils (vegetable as well as animal), fats, honeys, molasses, alcoholic liquors, urines etc.

Pure Ap (Mahabhuta) is tasteless and the six tastes are developed when the Mahabhuta Ap enters into combination, mechanical or chemical with other Mahabhutas. Susruta notes that various kinds of Earths are dissolved in the waters of different localities, and where the particles so dissolved are predominantly Earthy, the water tastes acid or salt,-where predominantly watery, the resulting taste is sweet,-where the Earth particles are mixed up with Tejas, the water tastes pungent or bitter etc. Such is the case with mechanical mixtures. In the case of bi-Bhautic or tri-Bhautic compounds Charaka mentions that substances with Mahabhuta Ap predominating in their composition taste sweet; with Mahábhútas Earth and Tejas predominating, acid; with Mahábhútas Ap and Tejas predominating, salt : with Mahábhútas Váyu and Tejas predominating, pungent; with Mahábhútas Váyu and A'kása predominating, bitter; and with Mahábhútas Váyu and Earth predominating, astringent (Charaka, Sútrasthána, Chap. 26,—cf. Susruta, Sútrasthána, Chap. 42).

In fact with the exception of Susruta's waters which are mechanical mixtures, or rather solutions, all these Ap-substances are organic products and, as such, penta-Bhautic, i. e. compounded of all the five Mahabhútas, and the particular 'taste' which is developed depends on the relative proportion of the Mahabhútas, and the predominance of one or more of them in the penta-Bhautic compound in question.

Qualities of Compounds.—The isomeric modes of each Mahabhúta have specific colours, tastes etc. due to their structure, i.e. the arrangement of their atoms, and the physico-chemical characters of compounds whether of the same or of different Mahabhútas result from the collocation in unequal proportion of the different forces latent in the atoms of the component substances. Charaka adds that the varied forms (textures) and colours of organic substances, whether vegetable or animal, are derived in the same way. एवमेनेवा रमाना वट्लमुपपर्श मनाविरेकविभेषान महामुवानाम् । स्वानामिन स्वावरणक्रमानां नानावयोक्तिविभेषा:।

Susruta ignores Charaka's distinction between Mahábhútá and subtile Bhúta, and views every substance as in reality penta-Bhautic and it is only the relative predominance of a particular Bhûta or Bhûtas in any substance that determines its class. (पविव्यक्तेजीवाशृक्तामाना समुदायात् द्रव्यामिनिशीतः। सन्वर्षम् पमिष्यम्भो भवति पदं पाविषे पदं पाव्य पदं निजनं पदं वायव्य पदं पावाभीयनिति। Susruta, Sútrasthâna Chap. 41)

The extant Charaka and Susrutu-Succession of medical authorities:—

The extant Charaka and Susruta, the sources of our present information regarding the progress of scientific knowledge in the medical schools of Ancient India, are both redactions of original authorities. The extant Charaka is a redaction by Dridhabala of the genuine Charaka Samhita which was itself a redaction by Charaka of the original work of Agnivesa, the disciple of A'treya Punarvasu as distinguished from Krishnátreya and Bhikshu A'treya, also well-known medical authorities. The extant Susruta is a redaction by Nágárjuna of an original work ( Vriddha Susruta ) by Susruta, the disciple of Dhanvantari. That Charaka preceded Susruta is almost certain. Nagarjuna was probably earlier than Dridhabala. At any rate, Dridhabala imported into Charaka much of the surgical knowledge which had till then been the traditional heritage of the Susruta school. And in the matter of the surgical treatment of certain diseases, the genuine Dridhabala is often as

advanced as Susruta's redactor himself. The latter was probably identical with the alchemist Nagarjuna (Siddha Nagarjuna), the metallurgist Nagarjuna ( author of a treatise on metallurgy, Lohas'astra ), and the Buddhist Nagarjuna, author of the Madhyamika-sutrayritti. Charaka and Susruta continued to receive additions after Dridhabala and Nagarjuna, and even after Vagbhata, but the whole of the extant Charaka is probably much earlier than the commentator Chakrapáni, and the whole of the extant Susruta earlier than Dalvana, the commentator, and Madhava, the auther of Rugvinischaya. The extracts in Vagbhata make it certain that the passages I have quoted or shall quote from the Sútrasthána and S'arirasthána of Charaka and Súsruta cannot be later than the sixth century of the Christian era.

Preparation of Chemical Compounds.—The knowledge of chemical compounds and of their preparation continued to make progress in the Charaka and Susruta Schools. The great metallurgist, Patanjali, in his treatise on Metallurgy (श्रीकास) gave elaborate directions for many metallurgic and chemical processes specially the preparation of the metallic salts, alloys and amalgams, and the extraction, purification and assaying of metals. Probably it was Patanjali who discovered the use of the mixtures called Vidas.

which contained aqua regia or other mineral acids in potentia. Unfortunately Patanjali's magnum cpus appears to have been lost, but extracts from it are frequently found in mediaeval works on Medicine and Rasayana, which leave no doubt as to its remarkable scientific value. The metallurgist Nagarjuna advanced the knowledge of chemical compounds by his preparations of mercury. The Harsbacharita, in the seventh century, relates a fable concerning this Nagarjuna, and speaks of him as a friend and contemporary of Sátaváhana. The relative priority of Patanjali and Nagarjuna is a vexed question in the history of metallurgy. That Nagarjuna's Lobasastra was earlier than the final redaction of Patanjali will appear from the following circumstances :- (1) Chakradatta in his summary of Nagarjuua mentions that the chemical process of testing pure iron must be repeated twice before it can be regarded as decisive, where as S'ivadása Sen's extract from Patanjali shows that the latter directed the process to be repeated seven times : (2) Patañjali in the Abhraka-vidhi (mica operation) adds mercury, which in this particular operation is wanting in Nagarjuna's recipe (cf. Chakradatta, and Patanjali as reported in the Yogoratnákara-sa muchchaya ); and (3) Nágárjuna is quoted in the earlier compilations, Patanjali in the later.

Early in the sixth century, Varahamihira in the

Vribat Sambitá gives several preparations of cements or powders called Vajra-lepa "cements strong as the thunderbolt;" and there was ample use for these in the temple architecture of the Buddhist period, the remains of which bear testimony to the adamantine strength of these or rock cements. metal ( प्रासादहर्के। बस्तमी सिक्-प्रतिमास कुराकृपेय सन्तप्ती दातव्यी वर्षशृष्टसायुतस्थायी । Chapter 56, Ibid. ). Varáhamihira also alludes to the experts in machinery (बन्धविद:, बन्दका:) and the professional experts in the composition of dyes and cosmetics (रागमश्युक्तिविद: Ch. 16, also Ch. 15). I would also refer to the interesting Chapter on Perfumery (Ch. 76) where Varáhamihira gives various recipes for artificial imitations of natural flower scents as of the essence of Vakula, Utpala, Champaka, Atimuktaka &c., arranges compound scents in a sort of scale according to the proportions of certain ground essences used in their preparation, and determines by the mathematical calculus of combination ( कोष्टकप्रसार ) the number of variations of the different notes in this scale. To these classes of professional experts were due three of the great Indian discoveries in the chemical arts and manufactures which India to command for more than a thousand years the markets of the East as well as the West and secured to her an easy and universally recognised pre-eminence among the nations of the world in

manufactures and exports :- (1) the preparation of fast dyes for textile fabrics by the treatment of natural dyes like Manjishtha with alum (तवरी मध्या रागर्जाभागी) and other chemical ( e. g. sulphate of iron ) also cow-dung (cf. the "cowdung substitute", Roscoe); (2) the extraction of the principle of indigotin from the indigo plant by a process which however crude is essentially an anticipation of modern chemical methods; and (3) the tempering of steel in a manner worthy of advanced metallurgy, a process to which the medieval world owed its Damascus swords. It was this applied chemistry much more than handicraft skill which gave India her premier position in the middle ages and earlier ( indeed from Pliny to Tavernier ) in exports and manufactures; for in handicraft skill as in design and workmanship, great as were her merits, India came to be surpassed by her disciples China and Japan.

The Vasavadatta and the Dasakumara Charita in the sixth century allude to the preparation of a mass of fixed or coagulated mercury (पारदविकास का का बात वादिन:—वास बस्सा); a chemical powder, the inhalation of which would bring on deep sleep or stupor (बीय चर्ण-द्यक्षमारचित्त); a chemically prepared stick or wick for producing light without fire (बीयवर्षिका—द्यक्षमारचित्त); and a powder which like ancesthetic drugs or curare, paralyses

sensory and motor organs ( सभावपूर्णमित किन्द्रयाचाम् — वास्वद्रभा— भौन्द्रयक्षणिन्द्रयाचामित इर्देष: ). Vrinda ( circa 950 A. D. ) notices the preparation of sulphide of mercury (रसायक्षण) composed of one part of sulphur, and half its weight of mercury; and also of cuprous sulphide (पपेटिताम्). Chakrapani ( circa 1050 A. D. ) mentions the preparation of the black sulphide of mercury, "by taking equal parts of mercury and sulphur".

The Rasárnava (circa 1200 A.D.) notices the colours of metallic flames, probably after Patañjali; e.g. copper gives blue flame; tin, pigeon-coloured; lead, pale; iron, tawny; blue vitriol, red. It may be noted that the Rasárnava regards mercury as a penta-Bhautic substance.

The Rasaratna-samuehehaya divides the mineral kingdom (Earth-substances, simple and compound) into the following classes:— (4) The eight Rasas, mica, pyrites, bitumen, blue vitriol, calamine, etc. (2) The eight Uparasas (useful in operations of mercury), sulphur, red ochre, green vitriol, alum, orpiment, realgar, collyrium, and medicinal earth, to which may be added the eight Sadharana Rasas, sal-ammoniae. cowrie, cinnabar, rock vermilion, etc. (3) The gems, diamond, emerald, sapphire, cat's eye, sunstone, moon-stone, pearl, etc. (4) The metals,

gold, silver, iron, copper, lead, tin, and the alloys—brass and bell-metal. Other Earth-substances are six salts, three alkalis, mineral earths, and several poisons (cf. vol. I, pp. 32-98).

Chemical compositions and decompositionsmetallurgic processes .- In these writings. frequently come across instances of chemical composition and decomposition, by processes. more or less crude, of calcination, distillation, sublimation, steaming, fixation, etc. ( अकीवरव चप:पातन, करंपातन, खेदन, कथन etc.) e.g. the preparation of perchloride of mercury by taking common salt and mercury (रतकपूर-पारदस वेत-भक्षीकरचे चन्द्रिकाकार: ); of sulphide of mercury (form) by taking sulphur and mercury; of from lead (विन्द्रं नागसभावन-Amarakosha sixth century A. D. ) ;-of the medicinal compounds, Svárna-sindúra and Rasasindúra, with mercury, sulphur and gold, where gold may have been fancied to influence the resulting compound in some mysterious way, either as a 'dynamic' or as a catalytic; - also the extraction by chemical decomposition of mercury from sulphide of mercury (दिश्व,-vide रसरवसमुखय); of copper from sulphate of copper (तुल, समक ) by heating this substance with one-fourth of its weight of borax ( Rasaratna-samuchehya,—cf. Bhávaprakása, क्यं

न तासीवधान किथिन तासेच तहबति); of zine (बदास. बहर ) from calantine ( रसव-Rasarnava ) ; of copper from pyrites ( माचिक, विमल, etc.— Rasárnava, (though the golden pyrites were supposed to be a semi-metal of gold, containing some gold along with the essence of copper )-the purifications of mercury by repeated distillation from lead and tin with which it was wont to be adulterated in the market. The various metallurgic processes described are-extraction, purification, killing (formation of oxides, chlorides and oxy-chlorides for the most part ), calcination, incineration, powdering, solution, distillation, precipitation, rinsing ( or washing ), drying, steaming, melting casting, filing, etc. to all which each of the known minerals was successfully subjected by the use of apparatus and reagents and the application of heat in different measures (खरपाक-मध्यमपाक- and बद्दपाक ),-methods which, if often crude, especially from the absence of independent and isolated mineral acids, were yet in several instances remarkably simple and effective, and which, after all by the use of various Vidas potentially containing mineral acids aqua regia, sulphuric acid, hydrochlorie acid, etc.) virtually accomplished the practical ends kept in view. To these were added several special processes for mercury (e. g. fixation). bringing up the number of mercurial operations to nineteen.

It may be noted that the mixtures called Vidas, which potentially contained dilute mineral acids, were regularly employed not only in killing the metals (forming their oxides and chlorides), but—what is of fundamental importance—for purposes of chemical decomposition of metallic salts, etc. and the extraction and purification of metals.

Organic Compounds,—Organic Compounds are either vegetable or animal substances ( स्वावर अक्रम सूत्र ). The molasses, the fermented liquors, the saps and juices of plants, fruit acids, vegetable ashes and alkalis together with the tissues of plants are vegetable compounds ( भीइट् स्वावर मूत्र ). Honey milk, curd, butter, fat, bile, urine, and other excreta, together with the organs and tissues of animals, are animal substances. Charaka notices vegetable as well as animal oils. The viscous (oily) substances are classed under four heads—butters, oils, fats, and marrows ( सर्विकेश वसा समा सेट्डा स्टब्युविंग: ). Salt may be either mineral or vegetable salt.

Susruta divides poisons into two classes - Vegetable and animal, but several poisons expressly termed mineral poisons ( भावृद्धि ) are included in the first class.

All organic substances, whether animal or vegatable, are penta-Bhautic, being compounded of greater or less proportions of the five Mahabhútas.

Taking the human body Charaka finds that the focus is composed of sixteen organic substances, viz. four, composing the Sperm-cell which comes from the male; four composing the germ-cell which comes from the female; four added by the transformation of the nutritive material, and finally, four kinds of subtile matter, which together form the vehicle of the conscious principle. As to the four organic substances which compose the sperm-cell, or the other four which compose the germ-cell, it is not clear whether in Charaka's view they are also in their turn compounded of less complex organic substances, or whether their constituent elements are inorganic penta-Bhautic compounds.

The tissues that appear in the course of developments of the fœtus are further transformations (higher compounds) of these fœtal substances. All the component substances of the body are penta-Bhautic compounds, though sometimes they are assigned to the particular Bhútas which predominate in their composition, e.g. bile to Tejas, lymph, chyle, blood, fat, urine, sweat and other secretions to Ap, and skin, flesh, bones, nails, hair, etc. to Earth. (का वायुक्तिभूषवृक्षपद्वत्।—वर्षस्य चलादि चतुर्विधानि स्वाधि

मातापित्रसम्बानि चादारजानि चाककतानि चैव et seq. Charaka, Sárírasthana, Chap. II. vide also Charaka, Sárírasthána, Chap. VII. ef. Gangádhara's Jalpakalpataru. पिर्श स्तीयं भूतं गरीरारचकतेजः प्रधानप्यभूत-विकारात्रकं तेजः सद्यप्रविश्वं स्त्रां च च्याप्य भूतमापः गरीरारचक्षिणः प्रधानप्य भूतविकारविश्वं । गरीरं तु प्रधमद्यः भूतविकारसमुदायाक्षकम् । Cf. Charaka Sárírasthána, Chap. IV. मालजादयोऽपि चस्य मद्यभ्वविकाराः ।)

Foetal Development ( after Susruta ). The ovum fertilised by the sperm-cell and developing under the influence of animal heat forms successive layers and tissues even as layers of cells and fibres are formed in wood. First are formed seven layers epithelial and dermal ( sway: ), then follow the several tissues ( wer: ), the flesh, the vascular tissue, the fat and marrow, the lymphatic (and glandular) tissue, the intestinal tissues, the biliary and the seminal vessels,-tissues which are regarded by some as modifications of the original dermal layers of the ovum (cf. the layers of the blastodern and their relation to the tissues in Embryology). The tissues are supposed to be developed successively, one out of another, by chemical action or metabolism ( पाक ). e. g. chyle is transformed into blood, blood into flesh, flesh into fat, fat into bone, bone into narrow, marrow into sperm-cell. The organs are next formed out of the tissues. The liver, gall-

bladder ( जोम ), spleen and lungs are referred to the blood; the intestines to the blood, lymph and bile; the kidneys to the blood and fat; the testicles to the blood, lymph and fat; the heart to the blood and lymph; and the tongue to the lymph, blood and flesh. Vayu, with the accompaniment of animal heat, impels the 'currents' (सोवासि) in the system ; Vayu acting on the flesh gives rise to the muscles, and it is Vayu again, which, with the essence of fat ( or marrow ), produces the nerves, arteries and tendons. ( तस सन् यक्षणीयतस प्रियणनामस चौरसेव सनानिका: सप्तवची भवनि।-कवा: खलपि सप्त समावित। यवाडि सार: काहेषु क्यमानेषु दश्यते। तासी प्रचमा मस्परा। दितीया रक्षथरा। सतीया मेदीधरा। चतुर्धी द्रेयधरा। पश्चमी पुरीवधरा। वडी पित्रधरा। सप्तमी गुक्रधरा।—गर्भस्य बक्षतप्रीहानी गोपितको ;-et seq Susruta, Sarirasthana, Chap, IV.-रमाटकं तती मांसं मांसाकोद: प्रजायते। सेटसीऽस्थि तती मज्जा मण: इक्रम स्थाप:। Sútrasthána, Chap. XIV.)

The following parts (tissues and organs) in the fœtus are in a special sense modifications of the four organic substances contributed by the sperm-cell of the male parent; hair, nails, teeth, bones, nerves, 'veins and arteries, tendons and ligaments, and the sperm-cell; the following, of the substances derived from the mother,—skin, blood flesh, fat, the heart, liver and spleen, kidneys, stomach, intestines, etc. (Charaka, Sárírasthána, Chapter III. यानि खलस गर्भस पिरजानि पिरतः समावतः समावतः, तद्वया नेग-ग्राम्य-भीम-दन्तास्थिविरा-साधु-धनन्यः ग्रज-भिति पिरजानि । यानि सलस्य गर्भस मारजानि यानि च चस्र मारतः समावतः समावत

Chemistry of Digestion-The food we eat contains five classes of penta-Bhautic organic compounds. From their radicles or predominant elements, the substances are named Earth-compounds, Ap-compounds, Tejas-compounds, Váyucompounds and Akasa-compounds. The Earthcompounds supply the hard formed matter of the body, the Tejas-compounds give the animal heat ( or the metabolic heat ), the Vayu-compounds are the sources of the motor force in the organism, the Ap-compounds furnish the watery parts of the organic fluids, and the A'kasa-compounds contribute to the finer etheric essence which is the vehicle of the conscious life. Roughly speaking, the Earth-compounds answer to the nitrogen compounds in the food, the Tejas-compounds to the hydro-carbons (heat-producing) and Váyu-compounds to the carbo-hydrates (dynamic). The Ap-compounds are the watery parts of food

and drink. The flesh, for example, is a tissue composed principally of the Earth-compounds, the fat of the Earth and Ap compounds, the bones of Earth Vayu and Tejas compounds. The Tejas compounds predominate in the composition of the blood. For purposes of digestion it is stated that different operations of the metabolic heat (perhaps different digestive fluids are also meant) are required to digest the different substances in the food.

The course of metabolism is described as follows:—The entire alimentary canal is called Mahasrotas (the great channel).

The food goes down the gullet by the action of the biomotor force, the Prana-Vayu.

In the stomach ( पानामय ) the food becomes mixed up first with a gelatinous mucus (केंग्रीसून कर्ष ) which has a saccharine taste, and then gets acidulated by the further chemical action of a digestive juice ( विदार स्वाच गव: )—evidently the gastic juice is meant. Then the biomotor force, the Samána Váyu, begins to act and drives down the chyle by means of the Grahami Nádi to the Pittásaya (duodenum), into which bile comes down from the liver, and thence to the small intestines ( the पामप्राणय ). In these, the bile ( or rather the digestive substance in the bile as opposed to the colouring element ) acts on the chyme, and converts the latter into chyle ( रच ), which has at first

a Katu taste (pungency). This chyle contains in a decomposed and metamorphosed condition all the penta-Bhautie organic compounds, viz. tissue-producing Earth-compounds, water parts or Ap-compounds, heat-producing Tejas-compounds, force-producing Váyu compounds, and lastly, finer etheric constituents which serve as the vehicle of consciousness. The essence of chyle ( क्षमान ) from the small intestines is driven by the biomotor force, the Prana Vayu, along a Dhamani trunk (cf. the thoracic duct) first to the heart ( which is a great receptacle of chyle ), and thence to the liver ( and the spleen ), and in the liver, the colouring substance in the bile acts on the essence of chlye, especially on the Tejas substance therein, and imparts to it a red pigment, transforming it into blood. But the grosser part of chyle ( खुलभाग ) proceeds along the Dhamanis, being driven by the biomotor force, the Vyana Vayu, all over 'the body.

When the blood has been formed, the essence of chyle in the blood, acted on by Vayu (biomotor force) and Mamsagni (the flesh-forming metabolio heat), forms the flesh tissue, the Earth-compound of the food substance especially contributing to this tissue. Of the flesh tissue thus formed, the grosser part goes to feed or replenish the flesh tissue all over the body. The finer essence of flesh in the

blood in the chyle, acted on again by Váyu (biomotor current) and the fat-forming metabolic heat (सदोडिय) in the menstruum of lymph (कम समाधिस), receives viscosity and whiteness, and produces the fatty tissue, the Earth-compounds and Ap-compounds of the food especially contributing to the product. This fat in the chyle (or blood), or rather the grosser part of it replenishes the fatty tissue of the body, but the finer essence of fat in the flesh in the blood in the chyle, acted on by Vayu (biomotor current) and the marrow-forming metabolic heat, in the menstruum of lymph ( swusa ), becomes hard ( or crystalline ), and forms bone, the Earth, Váyu and Tejas compounds contributing principally to the product. The essence of the fat fills the hollow channels of the bones, and acted on again by biomotor Váyu and metabolic heat, becomes transformed into the marrow. The marrow is transformed into the semen, which is conveyed down by means of a pair of Dhamanis (duets) ( र यक्तवह ), lodged in its receptacles ( ग्रक्रथरा—डवयो ) and discharged by means of another pair of ducts ( हे विसर्वाय ). The semen, or rather the elements in their finer essence, give off Ojas, which returns to the heart, the receptacle of chyle and blood, and again floods the body, and sustains the tissues, thus completing the wheel (or self-returning circle) of metabolism (परित्रिया प्रकार, Cf. Charaka and Vágbhata).

It is to be noted that, throughout, the fluid in the chyle (or blood) acts as the menstruum, though occasionally the lymph, which is itself a derivative from the chyle is added as in the case of the fatty tissue and the marrow; and that each preceding element or constituent of the body (wig-मरीरारक्षकथातु ) takes up the proper organic compounds from the food-chyle to form the next element or tissue. Throughout also, the chemical changes are due to the metabolic heat which breaks up the compounds and recombines, but the operations and even the vehicles perhaps of this heat are different. For example, these heat-corpuscles in the biliary ducts produce the bile, but the bile secretion is supposed to contain two distinct substances, (1) a digestive fluid in the duodenum ( विचायव ) which acts on the chyme to produce the chyle, ( बजल पक्षपाचकान्त्रं fue ); and (2) a colouring bile substance in the liver which adds a red pigment to the chyle and transforms it into blood (रश्चकाव्यं विश्वन्). Besides, there are three other biles, of which the acqueous humour in the eye is supposed to be one ( बाबोबकवित्रम् ) helping in the formation of visual images ( दपपादत्वन् ). This is the view of Dhanvantari and his school, but A treya holds there is no

evidence that the bile really performs the first (digestive) function, for this can be accounted for by the animal heat arising from the working of the whole bedily machine. There are three different hypotheses regarding the course of metabolism and the successive transformations of the chyle (चीरदक्षिनाय-केदारोकुन्यान्याय स्तृतिकशीतन्यायेति विधा धातुपीयणжи:- Chakrapáni, Bhánumatí, Sútrasthána, Chap. 14, S'loka 10; also his commentary on Charaka, Sútrasthána, Chap. 28), but my account is based upon the second hypothesis which has the preference of Ckakrapáni ( 1878; ). It may be added as a curiosity that each element of the body ( vig ) under the metabolic heat is supposed to give off finer essence ( मुजानाम ) which serves as the material of the next succeeding element, and a dross ( मल ), which forms some of the excreta. in the body (including the nails, the hair, etc. ), besides retaining its own substance (the gross or main part) . which is driven along by the Vavus (biomotor or vital currents) or by the Srotas to its destination in the body. Some idea of circulation appears to have been entertained, for the beart which receives and then sends down the chyle h the Dhamanis gets it back transformed

nood, and the Ojas also proceeds from the neart and returns to it along with the chyle and blood, (Cf. Vagbhata—वा: इत्सा: दशका भोज:

चभिवहत्त्वः )। पद्मशुताबाक्षे देशे चाहारः पायभौतिकः। विपन्नः पश्चमा स्वार्त्यान सामभिवर्धयेत्। Susruta, Sutrasthana, Chap. 46. Cf. also वियतप्रवनजातामां विश्वमाप्रीति मादत: । चार्ययमेन यददव्यं तेन पित्रमुदीर्थते। Ibid., Chap. 41. भीमाध्याचे वदायमा: पश्चीचाण: सनामसा:। वैचाहारगुणान स्वान स्राम् पार्धियादीन् पचन्दत्। यदास्यं ते च पुचनि पक्ता सूत-मुणान पृथक्। पार्थिया: पार्थियातीय श्रेषा: श्रेषांक देखगान्। पतिरिका गुषा रक्ते नहों ने तु पार्धनाः। मेदसपा भृत्यास्त्रि पृथिव्यनिस्तेत्रसाम्। Charaka, quoted by Dalvara. पादी षड्रसमयत नधुरीमृतनीरयेत्, फेथीमृतं ककं बातं विदाद्यादवाता तत:। वायुना समानाव्येन यहकीमभिनीयते। यही विश्वधरा नाम या कला परिकीर्श्ता। कामपकाशयानः छा यहकी साउभिधीयते। चम्यविष्ठानमञ्जल बहुबाइबहुवी महा। भुक्रमामात्रवे दहा सा विपाचा नग्रवाः। वलदश्यवला लज्ञमाममेव विमुचितः।...चद्रश्य पक्ष पित्रनु पाचकाव्यं पुरेशिस्म्। दीवधातु-स्लादीनासुम्सेन्या-वेदणासनम् ।...तेजीरसानां सर्वेदामस्युवानां यद्याते। पित्तीयपा सराविष रही रक्षलस्थाति। बायुग्रितेजसा युक्तं रक्षं मास-लग्च्छति। द्वेष्माणं च समाजिल मार्स वाञ्चिष्यं युत्रम्, स्थिरसा गाय भौकां च मेदो देवेऽभिजायते। एविव्यम्यनिलादीनां सहातः द्वेषायावत:। सारतं प्रकरीत्यस्य भावतेऽस्य तती नृपाम्। करीति तव शीविधमान्यां मध्ये समीरमः। मेदसा तानि पूर्धने केशी मज्जा ततः कृतः। तकानानृज्ञय यः केषः यकं संनायते ततः।

Charaka-Dridhabala Samhitá, quoted by Aruna in his commentary on Vagbhata. यथा केदारनियक्तं कुल्यात्रलं प्रस्वाधनो केटारीमाप्रावयति, शया रस एव प्रथमं रण प्रावयति। तप रक्तस्थान-सम्बन्धात् रक्तसादद्यं रक्तव्यद्वेतं च रत्भवति। रक्षंच रक्षसमानेन सीवनाधेन प्रसं पीषयति। तती रक्षमाधान्य मासमात्रातयति, एवमुत्तरोत्तरधात्म रस एव प्रावयति । (Chakradatta, Bhanumati). This passage shows that the 'venous blood' was conceived to be chyleessence mixed with blood, and that the circulation of the chyle so for as it was held to contribute its quota to the constituent elements and tissues of the body was really supposed to be identical with the circulation of the blood ( ततो रक्षमाश्राम मीस माञ्चवित ). This will be abundantly clear from the following account of the course of the chyle and the blood :-

ततः सारभूतसाधाररसस्य हो शागो भवतः। सूनः मुक्तसः...
ततः मुक्तो भागः प्राणवाधुमा प्रेरिती धमनीमार्गेण प्ररीरारभवस्य
रक्तस्य स्वानं यक्तत् प्रोण्डणं गला तेन स्वष्ट मिलितो भवति।
ततः प्राजन-रक्तधातौ एव तिष्ठति।......ततः सारभूतस्य भाषाररक्तस्य हो भागी भवतः। स्वूनः मुक्तयः। सूनो भागो रंजकास्येन पिक्तन रक्तीततः प्ररीरारभवं रक्तं पीषयम् व्यान-वायुना
वेरितो धमनीभिः संघरन् स्वलक्तरीरगतानि विद्रास्य पुक्ति।
ततः सूकी भागः व्यानवायुना प्रेरिती धमनीभिः विराभिय
वर्षरारभकाणि मौसानि याति। et seq.

This finer essence of chyle which nourishes the flesh must also be carried in the blood, on the 'irrigation channel' hypothesis (% दारी हुन्या या). (For diagrams of the central circulation and the sympathetico-spinal nervous system, vide my Paper on Hindu Anatomy and Physiology. The mechanism of life and the inheritance of specific and other congenital characters are also dealt with in the same paper).

Formation of molecular qualities in chemical compounds :- The Charaka school, which, we have seen, was an offshoot of the Sankhya (cf. Charaks, Vimánasthána, Chap. 8, यद्या शदिताः प्रकाशकः तथा सांस्थानवर्त प्रकामकामिति ) supplemented the above account of inorganic and organic compounds with a characteristically Sankhya explanation of the of molecular qualities by chemical formation combination. In Charaka's view, the colours, tastes, etc. of the molecules of chemical compounds result from the collocation in unequal proportion and unstable equilibrium of the different forces latent in the atoms ( Paramanus ) themselves. (एवनितेषां रसानां पदलसूपपत्रं विशेषात् मद्दाशृतानां। भृतानामिव स्थावरजङ्गमानां नानावर्षाकृति-विशेषा:। Charaka.)

Chemistry of colours. - As an interesting example of the way in which a follower of Charaka would account for the colours of chemical compounds, I may note the explanation given by the late Gangadhara Kaviraja Kaviratna in the Jalpakalpataru, a commentary on the Charaka-Samhitá, published at Calcutta in 1869, premising that the Kaviraja's view is pure and genuine Charaka doctrine. Gangadhara begins with a simple statement. The qualities of the atom, he writes, tend to produce similar qualities in the molecule. A molecular quality is therefore the result of the conjunction or opposition, as the case may be, of the atomic tendencies. When, for example, the five Bhútas combine to produce an organic compound (the human body ), Tejas, Ap and Earth tend to produce red, white and black respectively, but in the body (compound substance) the yellow colour may happen to be produced as the result of these tendencies in that particular proportion and collocation. The point to note here is that the molecule forms a fresh collocation, redistributes the Mass and Energy, and sets up new forces in the system which coming into play modify the potencies ( or tendencies ) in the component atoms and thus determine the resultant. This is elaborated into a curious but complete theory of the colours of chemical compounds.

The colours ( and other qualities ) of a simple substance (an isomeric mode of any Bhúta) are the result of the potencies lodged in that particular collocation of Mass, Energy and Essence. Now when two such substances unite, their colours etc. tend to be produced, but the combination brings on a fresh distribution of Energy, Mass and Essence, and the forces thus set free may powerfully modify or even extinguish the separate tendencies or potencies of the component simple substances. For example, when we prepare a collyrium by mixing equal parts of sulphur and mercury ( the black sulphide of mercury ), find the resulting compound black. explain this, it has to be remembered that each of the substances ( sulphur and mercury), contains Sattva (Essence), Rajas (Energy) and Tamas ( Mass ) in different proportions, and that predominant Tamas (Inertia, Mass) always produces black, predominant Sattva ( Essence ) white and predominant Rajas (Energy) red. Now in the black sulphide of mercury, the white of the mercury tends to produce white and the yellow of the sulphur yellow; and if these tendencies were not obstructed, the result would be a mixed colour. But, in the particular collocation in question, the Tamas of the mercury becomes intensive ( নীৰা ), and the black of the now intensive Tamas

extinguishes the white in the uncompounded mercury, which was due to prevailing Sattva, as well as the yellow of the uncompounded sulphur, which was due to the combined operation of white-producing Sattva and red-producing Rajas. Again, when, with proper apparatus and by the application of heat, we combine mercury and sulphur to produce the red sulphide of mercury, the resulting colour is explained by the fact that in this new collocation the Rajas (Energy)-probably of the merenry, though Gangadhara does not specify-becomes intensive ( and ), and extinguishing both the white-producing Sattva of the mercury and the yellow-producing Sattva-Rajas of the sulphur, imparts a red colour to the compound. In these cases, as also in the formation of red by mixing powdered termeric with lime, i.e., whenever a new colour is produced in the compound it is to be explained by the domia nance of Tamas, Rajas or Sattva, or their combinations, and the extinction of the uncompounded tendencies (or potencies) by the forces set free in the new collocation. But there are other cases where the colour of the compound is a mixed colour resulting from the colours of the combining substances, e.g., when sulphide of mercury and calcined tin are mixed, the resulting colour is evidently a mixed one (Pátala, pink), which is

easily explained by the colours of the component elements (the red of the sulphide of mercury and the white of the calcined tin ). In the same way, in a mechanical aggregate, as in a piece of cloth, the colour is white, where the threads are white.

(तत्कार्व्यारको पृथिकादिद्रव्यावस्थानुवा गमादयः सन् जातीयं नश्रविशेषादिकं पारभ्रमायाः यदारभ्रमायं सम्बदिनातीयं कार्य सारमकं कारण्य पहलारादिसां गुवांशं कुवचित् इला कुपित् न इला सजातीयं गुपविशेषं भारभने। यथा पारदरम्थकथी: संयीने कजातीमृतद्रव्ये पारदस्य: ग्रुक: ग्रुक-विशेषं पारभगायः गत्रकस्वयोतः पौतमारभगायः पारदस्रतीयां न तैरुणामारमगायेन विरोधिना बध्यते। सर्वतेव श्रीका' सत्तनुष्यशिनकं तमीयुषधीनिकेन तेपछीन विरोधिना वध्यते। बन्धकस्यपीतस्यी च सोडितवजी रजःसम्बद्धीनको वध्यते। तथीः युज्ञकीडितवधे तेरक-,समानधीन: क्रच: पश्चिमान्तते। इति पारदगशकीभयावाके कार्ये श्रेतपीतमेलनेन सन्धायं कार्ये बदवर्ग तत तीलाग्रेन क्यते, ततकारमं ग्रक्तलोडितं इला। एवं डिवर्ले पारदश्यकाश्यामारश्यमाणे यन्त्रविश्रेषे बाह्रमा पच्चमाने रजीवहलयीनिकेन तौर्घेन सन्तत्रमी-योगिकी ग्रक्तकची क्योते। पारदस्यग्रकत्मकस्यपीतस्थितेन सन्धान्य कार्थं वर्षे च बध्यते। रजीबीनिश्लोडियं च मांभव्यन्यते इति। एवं इरिटाच्यंसंयोगिऽपि लीहिलं पशिव्यनाते चूर्वस्यतेच्छोन हरिटास यतकणवर्षे। यय भवषे यया-हिङ्गावकभवासंयीने वेतलीहित-वर्षभेव सभयात्मकं भवति पाटलवर्षे, न च तत्र हिन्नुसह लीडिय' वह समास्थं श्रीका' च केनापि वध्यते। एवं ग्रक्तस्व-निर्णातपटल श्रीकामेव।) (Jalpakalpataru, Sútrasthánaof Charaka, pp. 198-200; edition published by Bhubanachandra Basák, Calcutta, Samvádaratnákara Press, Samvat 1925.) This is quite in a line with Charaka's explanation of the tastes of chemical compounds which has been already noticed.

Parináma-váda versus A rambha-váda : Charaka's view of the formation of a new quality or a new substance is based on the Sankhya teaching as to the conservation and transformation of Energy, and brings chemical synthesis in a line with evolutionary change ( uftern ). On this view, a new substance may arise by spontaneous or isomeric change, i.e., by the inter-play of Energies within the system of any given substance, in the absence of any action from without. New qualities like new substances are only readjustments of the old, and continual changes are going on by disintegration and recombination. spontaneous Opposed to this evolutional view of chemical synthesis is the Nyava-Vaiseshika doctrine of A rambba-vada, according to which no change of substance or quality, no effect, in short, can take

place except by the action of one component element (substance or quality) on another. A binary molecule, for example, cannot possess any 'specific quality' ( विशेषकुष ) of a kind not represented in each of the two component atoms. In the cosmic process, no atom can exist free and uncombined with another atom, and every 'specific quality' in a substance can be ultimately analysed into the union of two 'specific qualities' of the same class in two ultimate particles which cannot be further divided. A single colour, smell or taste in a single particle, until it can link itself on to another specific quality of its own class in a second particle, cannot characterise any substance formed by the of these particles as material causes. Hence an Earth-atom cannot unite with an Apatom, to form a new substance of which both the particles must be equally regarded as material causes. At any rate, such a compound, if effected, would be smell-less, as of the two consituent atoms, only one, viz , the Earth-atom, possesses smell. A compound of Earth and Vayu would be smell-less, colourless and tasteless, and so on. The Nyaya-Vaiseshika does not deny that there may be compounds of different Bhutas, nor does it deny the causal operation of specific qualities as efficient or energising (dynamic) causes (उपष्टक्षक, निमित्तकार्य) but it refuses to place

these compounds on the same footing as compounds of isomeric modes of the same Bhûta; and it accepts the 'material' causality, in such cases of only one of the Bhûtas, regarding the others as 'co-efficients' ( विविधकार्थ ).

The earlier Sankhyas including the medical schools of ancient India brushed all this aside as a distinction without a difference. The Vedantists, as we shall presently see, flouted this doctrine of A'rambha vada. The Jainas, in opposing this Vaiseshika view of atomic combination, hit upon a solution of the problem of chemical affinity. Others again, found out a via media. They held, as we learn from the reports of Udyotakara in the Nyáya-vártika, and of Váchaspati Misra in the Tatparyyatika, that a molecule of the structure EA (one atom of Earth and one of Ap) would exhibit some variety of colour and taste resulting from the joint action of the atoms and of their several colours and tastes. But as in the combination EA only the Earth-atom possesses smell, and the Ap-atom is smell-less, and as moreover no quality in a compound substance can result except from the joint action of the similar ( potential ) qualities of at least two component elements, it follows that a molecule of the structure EA would not manifest the energy of smell potentially contained in the Earth-atom.

Hence, admitting the combination EA for a smell-less compound, the upholders of this view would suppose a molecule of the type E<sub>2</sub> A ( i. e. two atoms of Earth and one of Ap ) to explain any bi-Bhautic compound of Earth and Ap ( like the plant saps and fruit juices ) which exhibits smell in addition to the peculiarities of colour and taste. (Cf. Váchaspati's comment on Udyotykara's refutation of this view:—

भयमभिस्तिः। पृथिन्याथपरमाणु तावते कं राणुकसारश्रश्च-मर्चतः तयोः स्परस्त्रमंगलेन तदारश्वस्थवं भवि गत्ववला-भावश्चहात्। एवं पार्थिशाच समर्थतस्य गत्तस्य एकलेन भनारश्च-कतात् नावि पार्थिवपरमाख्ययं एकय पायश्चीयपरमाणः दति भणनामारश्चकले गत्ववश्चीयपण्डिः दति साम्प्रतः। परमाणुनां वहनां भनारश्चकलात्। तथादि वयः परमाख्यः न कार्थमारभने।)

Measures of Time and Space. Size of atoms.

The Siddhanta-S'iromani gives the following measures of Time:

30 Kshanas = 1 day, 2 Ghatikas = 1 Kshana, 30 Kalas = 1 Ghatika, 30 Kashthas = 1 Kala, 18 Nimeshas = 1 Kashtha, 30 Tatparas = 1 Nimesha, and 100 Trutis = 1 Tatpara.

This makes a Truti of time equal to 33 125 of a second, which is nearly the measure of

the Paramanu of time; as given in the Vishnupurana (vide Bhäskara's Siddhānta-S'iromani— कारकमानाध्याय:)।

The above measures were in use among the astronomers, but the physicists computed according to the following table given both in Udyana's Kiranavali and S'ri-lhara's Nyayakandali:—30 Muhurtas = 1 day (24 hours), 30 Kalas = 1 Muhurta, 30 Kashthas=1 Kashtha, 2 Lavas=1 Nimesha, 2 Kshanas=1 Lava.

चणतर्थं खवः श्रीको निमेषस्य सनदयम् । चटादर्शनमेषास्य काठा विश्रम् ताः कला । विश्रम्कला सुद्धमेः स्नाम् विश्वद्वाचाद्वयौ च ते । ( Udayana, Kiranávali ).

This makes I Kshana of the Nyaya-Vaiseshika equal to  $z_3^2$  of a second. The Nyaya assumes that the unit of physical change (or the time occupied by any single antecedent step in a causal series before the succeeding step is ushered in) is equal to a Kshana (or  $z_3^2$  of a second). The astronomers were familiar with far smaller measures of time. The astronomical Truti of time measures about the thirty-four-thousahdth part of a second. This is of special value in determining the exact character of Bháskara claim to be regarded as the precursor of Newton in the discovery of the principle of the Differential Cal-

culus, as well as in its application to astronomical ropblems and computations. This claim, as I proceed to show, is absolutely established; it is indeed far stronger than Archimedes's to the conception of a rudimentary process of Integration. Bhaskara in computing the "instantaneous motion" ( तात्कास्कि गित ) of a planet campares its successive positions, and regards its motion as constant during the interval ( which of course cannot he greater than a Truti of time, though it may be indefinitely less ). This tátkálika motion is no other than the differentia of the planet's longitude, and Bapudeva Sastri claims that both the conception of the instantaneous motion and the method of determining it plainly show that Bháskara was acquainted with the principle of the Differential Calculus. On the data before him, Mr. Spottiswoode remarks that Bapudeva Sastri "overstates the case." Bhaskara "makes no allusion to one of the most essential features of the Differential Calculus, viz., the infinitesimal magnitude of the intervals of time and space therein employed. Nor indeed is anything specifically said about the fact that the method is an approximate one," "With all these reservations" Mr. Spottiswood continues, "it must be admitted that the formula he establishes and the method of establishing it

bear a strong analogy to the corresponding process in modern mathematical astronomy" (viz., the determination of the differential of the planet's longitude,-by no means the first step in transcendental analysis or in its application to astronomy). And Mr. Spottiswoode concludes by stating that mathematicians in Europe will be surprised to learn of the existence of such a process in the age of Bhaskara (circa 1150 A. D. -born 1114 A. D.). Mr. Spottiswoode's second objection that Bhaskara does not specifically state that the method of the Calculus is only approximative cannot be taken seriously. The conception of limit and the computation of errors came late in the history of the Calculuses of Fluxions and Infinitesimals. For the rest, Bhaskara introduces his computation expressly as a "correction" of Brahmagupta's rough simplification. The first objection ( viz., that Bhaskara makes no allusion to the infinitesimal magnitude of the intervals of space and time employed) would be more to the point, if it were well founded. But it is not, and Mr. Spottiswoode's error was due to the insufficiency of the data supplied to him. As a matter of fact, even Bhaskara's unit, the Truti of time (or Paramanu), is exceedingly small as the very name implies, being about one thirty-four-thousandth of a second of time. And in the passage in which Bhaskara describes the process, he distinguishes

between Sthúla-gati and Súkshma-gati (velocity roughly measured, and measured accurately ie, by reference to indefinitely small quantities, for Súkshma, as we have seen, has always a reference to the Anu, the indefinitely small). Indeed he expressly mentions that the Sthula-gati takes only Sthula-kala (finite time) into consideration, and that the determination of the Tatkaliki Gati ( Súkshma-gati ) must have reference to the moment ( प्रतिचयम् ), which is an indefinitely small quantity of time being of course smaller than his unit, the Truti. (Cf. इयं किल खुला गति: घट नुका तात्कालिकी कष्यते.....यदा दासञ्जिक्षयत्रसदा तात्कालिका गया तिथिसाधनं कर्त्तं युव्यते । तथा सभीयचासम्य । यदा तु दूरतरिक्षयनः ट्रवासनं वा चन्द्रस तदा बायया खुलया कर्तुं बुन्यते खुलकासलात्। यतकन्द्रगति: महस्त्रात् प्रतिचयं समा न भवति चतकदये चर्य विश्वविश्वविद्याः ;-nothing can be clearer than this conception of 'momentary' motion,-Bhaskara, Siddhánta-S'iromani, Ganitádhyáya, Gatisphutíprakarana : cf. also प्रतिचर्य सा न समा महस्तत:, ibid., cf. also Goládhyáya, Tátkálikí-karana-vásaná-prakarana, where Bhaskara points out that the mode of computing adopted by the Acharya (Brahmagupta) is a rough simplification. The computation of relative motion and the idea of resolved components of motion were of course familiar to

the astronomers.—(Cf. एवं गुजाचार्थंच नायवाचे रहचटी-श्रम्भाची गांवकचा चर्मनिचाः। ibid.) I may add en passant that Bhaskara's formula for the computation of a table of Sines also implies his use of the principle of the Differential Calculus.

Measures of weight and capacity. The Amarakosha mentions measures of three kinds—weight, length and capacity (भागं तुलाक्ष्मित्रीक:).

The Krishnala (Guñjā, Raktikā, the black and red berry of the Shrub Abrus Precatorius) was employed as a natural measure of weight. 80 Krishnala berries on the average weigh 105 grains Troy, and this must be taken as the basis of our computation, though in current practice 80 Krishnalas are taken to be equivalent to 210 grains. One Krishnala was supposed to weigh as much as 3 medium-sized barley seeds ( स्थापन ), one of the latter as much as 6 white mustard seeds ( स्थापन ), one white mustard as much as 3 Raji mustard seeds ( राजिन्ह्येंप ), one of these seeds as much as 3 Likebas, and one Liksha as much as 8 Rajas or Trasarenus.

We now come to conventional measures. One gold Máshá was the weight of 5 Krishnalas of gold, I Suvarna or Tolá weighed as much as 16 Máshás, and one Pala as much as 4 Suvarnas or Tolás. A Pala of gold therefore weighs 320 Krishnalas (Manu, Chap. VIII, Vishnu, Chap. IV, and Yájňavalkya, Chap. I).

A Máshá of gold therefore would weigh 6%. grains; a Tolá, 105 grains (in current practice it weighs nearly double as I have stated); and a Pala, 420 grains Troy,

The measures for silver were the following:—
1 Silver Masha = 2 Krishnalas, 1 Dharana = 16
Silver Mashas and 1 Pala = 10 Dharanas. A Pala
of silver would therefore weigh 320 Krishnalas.
In other words, the Pala was a fixed measure of
weight, and was equal to about 420 grains Troy,
or double this, if we take the Krishnala of current
practice.

A Pala, which equals 320 Krishmalas, was subdivided by 4, 16 and 5 successively for gold, and by 10, 16 and 2 successively for silver. A Suvarna (or Tolá) of gold corresponds roughly to a Dharana of silver, and a gold Máshá to a silver Máshá, but the sizes (or volumes) are not the same, and we must not therefore conclude that gold was supposed to be heavier than silver in the proportion of 5 to 2.

We find that 1296 Trasarenus equal 1 Krishnala. A Trasarenu, as a measure of weight, therefore, is the equivalent of a v of a grain Troy or double this according to current measures.

But the Trasarenu of physics is a different conception. It stands for the minimum visible, i.e., as the physicists define it, that which is just discernible as a glancing particle in the slanting beams of the morning (or afternoon) sun, coming into dark room through a chink or orifice of a window. This is a measure of size (or rather stimulus limen),

Measures of Capacity. Here the standard was furnished by the Kudava ( 1954 ), a vessel described as 3 Angulis long, 3 Angulis broad, and 1½ Anguli deep,—with a cubical capasity of 13½ cubical Angulis. 4 Kudavas=1 Prastha, 4 Prasthas=1 Adhaka, 4 Adhakas=1 Drona, and 4 dronas=1 Khárí or Bhára.

1 Khárí or Bhára.

24 Angulis make 1 Hasta, cubit, which may be taken to be 18 or 19 inches. A Kudava was divided into 4 Palas, and there can be no doubt that originally water of the weight of 4 Palas was found to be actually contained in a vessel of the cubical capacity of a Kudava. If we take the ancient cubit to have been 19 inches, the Kudava would contain nearly 4 Palas of distilled water at 30 Centigrade. On a cubit of 18 inches, the Kudava would contain about 3<sup>3</sup>/<sub>4</sub> Palas.

The Kudava in current medical practice is supposed to represent a cubical vessel, each side being 4 Augulis. This would give a capacity of 27 cubic inches, if we take the modern cubit of 18 inches. The Kavimijas take a Kudava to contain 8 Palas of water, and as 1 Pala=320 Krishnalas, and 80 Krishnalas are now taken to be equal to 210 grains Troy, a vessel of a capacity

of 27 cubic inches is accordingly supposed to contain about 6720 grains Troy,—which is not very wide of the mark, being about 1.3 per cent short for distilled water at 86° Fahrenheit or 30° centigrade.

Size of the minimum visibile; size of an atom. The supposed thickness of the just discernible mote in the sunbeam called a Paramánu in Technology, S'ilpa-sastra, (and a Trasarenu in Natural Philosophy, follows directly from Varáhamihira's table :- 8 Paramanus make 1 Rajas (or Ratharenu,-cp. the Mánasára), 8 Rajas make 1 Bálágra ( filament of hair), 8 Bálágras make 1 Liksbá, 8 Likshas make 1 Yúka, 8 Yúkas make 1 Yava, 8 Yavas (the Manasara has 4) make I Anguli (superior), 24 Angulis make 1 Hasta (cubit, lesser cubit, 18 inches). The thickness of the minimum visibile (the finest perceptible mote in the slanting sunbeam ) is therefore taken to be 3.2-10 or satura of an inch. The volume of a spherical Trasarenu ( or Paramánu of the S'ilpa-sastra ) would therefore be \$. \pi 33.2-63 of a cubic inch. It may be here noted that such a Trasaresu is supposed in the medical schools to contain 30 chemical atoms ( Paramanus of Natural Philosophy ) according to one estimate, or 60 according to another. The size of an atom must then have been conceived to be less than π.3.5-1, 2-62 of a cubic inch. परमायरकीवालायकिष्युकं यबीऽकृतं चिति घष्टगुवानि यथीत्तरम् सद मेकं भवति संख्या—Varáhamihira, Vrihatsamhitá, chap. 57. S'loka 2—जालानरगते भानी यदस्तरं दर्मनं रजी याति तदियात् परमासुं प्रथमं तदि प्रमाणानाम्। ibid., S'loka I,—Cf. Utpala, तत्परमासुं नाम प्रमाणं जानीयात्। प्रमाणानां सर्वेषां तत् प्रयमनादां प्रमाणं परमासुसंचम्। Cf. also, वसरेपान् विचेषः विवास परमास्थिः)।

The magnitude of a Paramánu is called Párímandalya (पारिमाखन्य) in the Nyaya-Vaiseshika, the name suggesting that the Paramanus were conceived to be spherical in shape, The Nyaya-Vaiseshika calls a Paramanu a mere point without any dimensions, but in the Sankhya-Patanjala, a Paramanu, though indefinitely small, had still dimensions, being divisible into Tanmatras, which were themselves integrations of Bhutadi. The diameter of a spherical Paraminu must have been conceived to be less than 3.2-20 of an inch (i.e. less than the conventional Paramanu with which linear measures begin ), and the volume of a Paramanu would therefore, in accordance with Bhaskara's formula, be smaller than \$ 7.33,2-63 or  $\pi.3^{\circ}.2^{-6}$  of a cubic inch where  $\pi = \frac{3}{1}\frac{9}{8}\frac{7}{8}$ . The Tanmátras were conceived as smaller still.

That these were conventional measures arbitrarily assumed goes without question, for, of course, the Hindus had no physical data for a mathematical calculation of these minute quantities. A Bálágra (hair-tip, or finest filament of hair), for example, is taken to be 3.2-1+ of an inch

thick, i.e. less than one five-thousandth fraction of an inch in thickness; and a fibril of the networks of Dhamani or Nadi (nerve) that supply the pores of the skin (papille ? मुखानि रोमकुपप्रतिबद्धानि, Susruta ) was supposed to be about a thousandth part of the finest hair in thickness, or This of the 'minimum visible', and therefore about 3.10-32-1: of an inch thick (cf. मुखानाड़ीपचारत: रीय: सदयमार्गन तुल्यास प्रचरति. Panichadasi), but it is evident that these measures were arbitrarily fixed upon, instead of being arrived at by calculation or actual measurement. Indeed, Charaka expressly states that the number of Sirás and Dhamanis in the body (three million fifty-six thousand nine hundred) is only a conjectural estimate पनिहासका पर तकांग्रेव -- S arirasthana, Chap. VII).

My account of the chemistry of the Sankhya-Pátañjala, and of the affiliated Yoga and medical schools, has anticipated in several points the views of the Vedanta and the Nyáya-Vaiseshika. The chemical facts, processes and apparatus are indeed common to all the schools. In the following accout of the chemistry of the schools other than the Sankhya Patañjala, I will confine myself to the theory of the subject, and even of this I will attempt only the briefest outline.

The Vedántic view :-

The Vedántists believe Máyá to be the 'material cause' ( उपादानकारक ) of the world. The power

of Máyá is the power to realise the unreal-to impart practical Reality or mediate existence to that which does not and cannot possess absolute Reality or self-existence. Máyá is at once reai and unreal, while the Brahma (Self) is absolute Reality, absolute Intelligence and absolute Bliss. The world evolves out of Máyá ( मायापरिचाम) so that Maya in the Vedanta replaces the Prakriti of the Sankhya. But Maya, and by implication the world, originate out of Brahma, not by a process of evalution ( परिचाम ), but of Vivarta ( self-alienation ). The self-alienation of the Absolute, acting through Maya, produces in the beginning A'kasa, one, infinite, ubiquitous, imponderable, inert and all pervasive. The world thus begun goes on evolving, in increasing complexity. The other Sukshma Bhutas classes of subtile matter, evolve from A'kāsa, in an ascending linear order,-A'kasa giving off Vayu, Vayu giving off Tejas, Tejas giving off Ap, and Ap giving off Earth. A'kása, one, infinite, all-pervasive, has the capacity of sound. Vayu, subtile gaseous matter, emanates from the universal A'kasa and is instinct with the potential of mechanical energy (impact, pressure ). दूरण, प्रचामिल, वसन, व्यवन,-वाशीय सुर्वा-सर्वाविनाभृतलात्-Vidvanmanorañjiní). चेष्टा हेत्रले न Tejas, subtile radiant matter, emanates from Váyu, and contains in potentia the energy of light and heat. Ap, subtile viscous matter, is the

transformation of Tejas, and is instinct with the energy that stimulates the nerve of taste, and lastly, Earth, subtile hard matter, which is the transformation of Ap, possesses the latent energy of smell.

But the subtile rudiments of matter must be compounded in various ways, to give rise to the gross constituent matter of the world. These forms of gross matter are called Mahabhútas. There are five kinds of Mahabhúta (gross matter corresponding to the five Súkshma Bhútas (subtile matter, and the process by which a Mahabhúta is produced from the Súkshma Bhútas is called Pañchíkarava (quintuplication). All the five Súkshma Bhútas are present as ingredients, though in different proportions, in each Mahábhúta,

The Mahábhúta Earth, gross earth-matter, is composed of four parts of subtile earth-matter, and one part each of the other forms of subtile matter. The Mahábhúta Váyu is composed of four parts of subtile gaseous matter and one part each of the other forms of subtile matter. And similarly with other Mahábhútas.

Hence if ak, v, t, ap, e, represent the five forms of subtile matter (A'kasa, Váyu, Tejas. Ap and Earth), and AK, V, T, AP, E, stand for the corresponding Mahábhútas, we may represent the constitution of the Mahábhútas as follows:—

AK = ak<sub>4</sub>. (v<sub>1</sub>. t<sub>1</sub>. ap<sub>1</sub>. e<sub>1</sub>), ak<sub>4</sub> being the radicle.

V = v<sub>4</sub>. (ak<sub>1</sub>. t<sub>1</sub>. ap<sub>1</sub>. e<sub>1</sub>). v<sub>4</sub> being the radicle.

T = t<sub>4</sub>. (ak<sub>1</sub>. v<sub>1</sub>. ap<sub>1</sub>. e<sub>1</sub>), t<sub>4</sub>, being the radicle.

AP = ap<sub>4</sub>. (ak<sub>1</sub>. v<sub>1</sub>. t<sub>1</sub>. e<sub>1</sub>), ap<sub>4</sub> being the radicle.

E = e<sub>4</sub>. (ak<sub>1</sub>. v<sub>1</sub>. t<sub>1</sub>. ap<sub>1</sub>), e<sub>4</sub> being the radicle.

In forms of gross or compounded matter, the potential energies (or qualities) become actualised.

The Mahabhūta Akasa manifests sound; Váyu, sound and mechanical energy; Tejas, sound, mechanical energy and heat-light; Ap, the energy of the taste-stimulus in addition; and finally Earth the energy of the smell-stimulus added to the foregoing.

The Panchadas's characterises the different Mahabhutas by their typicial sounds; e.g., Akasa by the echo (hollow booming sound); Vayu (air) by a sibilant sound, hissing, susurration (imitative symbol, Visi); Tejas (fire) by a puffing (or roaring) sound (imitative symbol, Bhugubhugu); Ap (water) by a liquid sound (imitative symbol Culu Culu, gurgle, plash-plash, glut-glut); and finally Earth by a splitting or rattling sound, a crack or a thud (symbol, kad-kada)—Chap. II. Bhutaviveka, S'loka 3, Panchadasi, cf. also Jayanta, Manjari.)

Others hold that A'kása, Ether, never enters as a component part, and is always one and indivisible. In this view, the four Mahábhútas—Váyu, Tejas, Ap and Earth alone are supposed to be com-

pounded, and by a process which may be called quaternion (cf. the Neo-Platonist quaternion ):—

$$V = v_{3} (t_{1}, ap_{1}, e_{1})$$

$$T = t_{3} (v_{1}, ap_{1}, e_{1})$$

$$AP = ap_{3} (v_{1}, t_{1}, e_{1})$$

$$E = e_{3} (v_{1}, t_{1}, ap_{1})$$

These compound forms, as before, are supposed to exercise their specific energies actively. Others again hold that the Mahabhútas—Tejas, Ap and Earth alone are compounded by a process named Trivrit-karana (triplication). Thus T-t<sub>s</sub> (ap<sub>1</sub>, e<sub>1</sub>), AP=ap<sub>s</sub> (t<sub>1</sub>, e<sub>1</sub>), E=e<sub>1</sub> (t<sub>1</sub>, ap<sub>1</sub>).

The Súkshma-bhútas are forms of homogeneous and continuous matter, without any atomicity of structure; the Mahabhútas are composite; but even these are regarded as continuous, and without any atomic structure. The Vedánta speaks of Anu (Paramánu) not as an ultimate indivisible discrete constituent of matter, but as the smallest conceivalle quantum or measure of matter. In the Sankhya doctrine, the atomic structure is ordinarily accepted. The Gunas are supposed to be परिच्छित्र and चम् bounded and indefinitely small in size (except the Gunas giving rise to A'kasa and Manas which are unlimited suffices); and hence the Tanmatras and Paramanus must be conceived to have a discrete structure.

As I have already noted in my account of the genesis of Tanmatras and Paramanus, various schools of Vedántists (e.g. the Ramanujists and the followers of Nimbarka ) combined, in the orthodox fashion of the Smritis and the Puranas, the Vedántic theosophy with the Sankhya cosmology especially as regards Prakriti and the order of creation and dissolution. For example, the Vedántakaustubhaprabhii. fortifying itself with texts from the Vishnu Purana and the Subala and Gopála Upanishadas, contends that at the cosmic dissolution (Pralaya), each Mahábhúta merges into the one that preceded it in the order of creation by first disintergrating into its own proper Tanmatrie form ( तकावदारा ), and that the Mahabhuta A'kasa merges into the original Tanmatras, which then lapse into Bhutadi, the supersubtile rudiment matter, proto-matter (Chap. II, Pada 3 Sutra 14).

Parinama—Evolutionary Process:—When the Mahabbutas are once formed, the different kinds of substance are derived from them by the evolutionary process called Parinama (परिचास, transformation). Matter is constantly undergoing change of state. The effect is only the cause in a new collocation (कारणक्षेत्र संख्यानमार्थ कार्यस्). Change is of twe kinds:—

(1) Change by a spontaneous process, without external influence, including isomeric change ( স্বাধাৰিক ঘহিতাল). The Vedantists believe in spontaneous disintegration and reintegration. Action from without, impressed force ab extra, is not, pace the Naiyáyikas, always a condition of change of state (whether of rest or of motion);—nor is it necessary that more than one substance should combine to generate another substance or variety of substance (c. g. the formation of curds from milk, of ice fram water etc.). All this is directed against the Nyáya doctrine (A'rambhaváda).

Change due to combination with other substances (इन्हानरसंबोग). Such combination may produce (1) a compound substance possessing like qualities with the constituents ( ममाननातीयीत्पति ). or (2) unlike compounds with new qualities, "heteropathic effects" (विजातीधीतपणि ). Any new quality thus evolved through (chemical) combination io called Samhata-bhúta-dharma चंद्रतभूतपर्क), e. g. the intoxicating power of the fermented rice and molasses, which does not exist in the ingredients (संदाबीजाना प्रत्येकं भवनैमानापि taken separately. समुदायम्बा मदमकि: इस्रवे \ This Sambhúyakriyā (सम्बद्धिया, समुद्धान ) corresponds to chemical combination, and the Vedantists, like the Sankhyas, explain this only as the evolution of the latent energy ( शक्ति, चनुइतशक्ति ) in a new collocation (संद्यान, चनवन-सन्तिचेत्र). But, unlike the mediæval Sánkhya, the Vedánta freely recognises the combination of heterogeneous Bhûtas. Thus, Earth, Ap, Tejas and Vâyu freely combine in different proportions and groupings to produce the variety of substances in the world. For example, the animal organism is a compound of all the five Bhûtas ( पाय-भीतिक ). It is not merely the concomitant or efficient causes that may be heterogeneous to the material cause, as the Naiyâyikas contend, but sevaral heterogeneous substances or (Bhûtas) may unite as 'material causes' to produce a new substance.

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The Vedantists resolve all activity, physical, vital as well as psychical, into modes of motion, subtile cosmic motion (परिस्थन, सर्वजीकपरिस्थन्द-S'ankara ; वाशीः परिस्पन्तात्रकतात्,-प्राचस परिस्पन्तक क-लादिब-यद्द तं स्त्रभं मुखं च तत्त्रभं मन:स्वस्थितमावम्-S'ankara); but they give a separate substantive existence to the agents, the vital principle ( sig ) and the mind ( सन: ), though these are also evolutionary transformations of the Sükshma Bhútas (forms of subtile matter ). What is common to the Nyava. the Vedanta and the Sankhya is that Consciousness or Intelligence ( 484) transcends Matter; but the Naivávikas as pluralists hold that vital and psychical activities are also immaterial and cannot be resolved into motion ( परिखन ) :- the Vedántists resolve these activities into subtile motion, but

ascribe them to a substantive quasi-material Life Priciple and Mind, the all-mirroring Intelligence (चेन्स) alone being immaterial and transcendent: and the Sankhyas accept the substantive existence of the Mind principle (सन:) as derived co-ordinately with the Sankhyas Bhūtas or Tanmátras from individualised prakriti (Ahankára), but resolve Life into a mere resultant activity of the bodily organs, viz. the organs of sense and movement, and the psychie principle (सन:).

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पश्चीकरण:--शिक्षा विश्वाय चैकेकं चतुर्वा भयमं पुन:। सामेकरदिकीयांभैशीजनात पश्च पञ्च ते।

यथा विस्तंत्रती सहानां भूतानां कुटतरव्यवदारनामदपक्ष करचीपायतया विस्तृकरणं युतं तदत् भृतपखक्षमंत्रती चित्र तथा। तदानीं
पश्चीकरणानारं चाकाम मन्दीऽभिव्यव्यते कुटतयित छन्नेव योजनीयं
(विद्यमनीविजनी)—चित्र दि मरीरे सर्वेषामपि भूतानां कार्यसंगतिपत्तिः चवकामन्द्रकृष्टनपवनकं दनकाठिनानां सर्वेजनानुभवसिद्धलात्।
चतक्त्वत्रारंपतदा पञ्चानि भूतानि एकक्षित्र देवे सन्तीति स्तिते
तन्तुपटवीरिव चवयवावयविज्ञमेव पञ्चभूतदेष्ट्यीयुंतं। न च सर्व्यमुगलात्
एकद्रव्यलात् च चाकामस्य चारभकत्वानुपपत्तिति वाच्यं। चारभवादस्य चनद्रीकारात्। एकसापि दुष्पावयविजनी दश्यारभकत्वदर्यनात।
वादस्य चनद्रीकारात्। एकसापि दृष्पावयविजनी दश्यारभकत्वदर्यनात।
वादस्य चनद्रीकारात्। एकसापि दृष्पावयविजनी दश्यारभकत्वदर्यनात।

न तावत् समानजातीयमेव भारभने न भिन्नजातीयमित नियमी
नात्ति । समाविकारचं एव समानजातीयलाध्युवनमः न कारणात्तरविषय इति तद्दिष भनेवालिकन्। नापि भनेकमेव भारभते नैकमिति
नियमोऽलि। भणमनसीरायककारभाष्युवनमात्। एकेकी हि परमाधसार्य सक्यारभने न द्रव्यानरे: संहत्य इत्यभुवनमाते। द्रव्यारमी एक
भनेवारभकतन्तियम इति चेत् न परियामाध्युवनमातः। तद्देव तु
द्रव्य विशेषवद्वक्यानरं भाषयमानं लाखे नामाध्युवनमातः। तम्र क्षाचित्
भनेकं परियमते सहीकादुरादिभावेन, काचिदेकं परियमते चौरादिदश्यादिभावेन। नेत्ररमासनं भन्नि भनेकं एव कारणं काळे जनयति
इति ! Sankara, Sariraka bhashya, Sutra 7. Pada 3,
Adhyaya II).

Vaibháshikas and the Sautrántikas hold that the Váyu-atoms are touch-sensibles, having impact or pressure for their characteristic property, and by aggregation from the element Váyu; the Tejas-atoms are colour-and-touch-sensibles, having heat for their characteristic, and by aggregation from the Tejas Bhúta; the Ap-atoms are taste-colour-and-touch-sensibles with a characteristic viscosity, and form the Ap-element by aggregation; and finally the Earth-atoms are smell-ta-te colour-and touch sensibles possessing a characteristic dryness or roughness ( was ), and by their aggregation form the Earth-element. The Bhútas

thus originated combine to form aggregates, which are classed as inorganic substances, organisms and ( कामेऽस्ट्रव्यकोऽष:-Udyotakara's organs. extract from the Buddhist Sútras, Nyaya Vartika. Chap. I. A'hnika I, Sütra, 14, cf. Váchaspati's fuller extract :-ष्टद्रवाकोऽसरमन्दः ६वधातुर६वधातः कामधातः—also का मे the Budhist commentary :- काम कामधाती चष्टद्रव्यक: इपरसन्भक्षमी इति चलारि द्रव्याचि प्रविव्यपतेशीनायुः 1:00 चलारि-Váchaspati. Tátparyyatíká. loc. cit.-इति also खरखेडीचेरचसभावानि भूतानि-vide Udyotakara, Chap. III, A'hnika 2, Sútra 12,-Vide also S'rinivasa's Vedanta-kaustubha, Chap. II, Pada 2. Sútra 18).

The atomic theory of the Jainas:—Of the nine categories of the Jainas, that of Ajíva (the not-soul or non-Ego) consists of five entities, four of which are immaterial (भूमां), viz., merit, demerit, space and Time, and the fifth, material (भूमां, possessing figure). The last is called Pudgala (matter), and this alone is the vehicle of Energy, which is essentially kinetic, i.e. of the nature of motion. Everything in the world of not-soul (the non-Ego) is either an entity (२०३), or a change of state in an entity (पदाव). Pudgala (matter) and its changes of state (पदाव), whether of the nature of subtile motion (परिचाद) or of Evolution (परिचाद), must furnish the physical as opposed to the metaphysical basis of all our explanations of Nature. Pud-

gala (Matter) exists in two forms,-Anu (atom) and Skandha (aggregate). The Jainas begin with an absolutely homogeneous mass of Pudgalas, which, by differentiation (भेद) breaks up into several kinds of atoms qualitatively determined, and by differentiation, integration, and differentiation in the integrated ( संघातात, भेदात, संघातभेदात-Umásvátí, Chap. V, Sútra 26 ), forms aggregates (Skandhas ). An Anu has no parts, no beginning, middle or end. An Anu is not only infinitesimal, but also eternal and ultimate. A Skhandha may vary from a binary aggregate ( दावक ) to an infinitum ( अनलायक). A binary Skandha is an aggregate of two Anus ( atoms), a tertiary Skandha is formed by the addition of an atom (Anu) to the binary ( राज्य ) and so on ad infinitum. The ascending grades are (1) what can be numbered ( रख्ये ), (2) indefinitely large ( पसंख्ये ), (3) infinity of the first order (चनल), (4) infinity of the second order ( धननावन ), and so on.

General Properties of Matter :-

The specific characters of the Pudgalas (Matter) are of two kinds, (1) those which are found in atoms as well as in aggregates. and (2) those which are found only in aggregates. Qualities of touch, taste, smell and colour come under the first head.

The original Pudgalas being homogeneous and indeterminate, all sensible qualities, including the infra-sensible qualities of atoms, are the result of evolution (परियाम). Every atom thus evolved possesses an infra-sensible (or potential) taste, smell and colour, (one kind of each ) and two infra-sensible tactile qualities, e.g. a certain degree of roughness or smoothness (or dryness moistness?) and of heat or cold. Earth-atoms, Ap-atoms, etc. are but differentiations of the originally homogeneous Pudgalas. The tactile qualities ( ur. fan, un, nid) appear first, but qualities of taste, smell and colour are involved in the possession of tactile qualities. An aggregate (Skandha), whether binary, tertiary or of a higher order, possesses (in addition to touch, taste smell, and colour ) the following physical characters :- (1) sound, (2) atomic linking, mutual attraction and repulsion of atoms, (3) dimension, small or great, (4) figure, (5) divisibility, (6) opacity and casting of shadows, and (7) radiant heat and light.

Sensible qualities. Tactile qualities are of the following kinds—hardness or softness, heaviness or lightness (degrees of pressure), heat or cold, and roughness or smoothness (or dryness and viscosity?). Of these, the atoms (Anus) possess only temperature, and degrees of roughness or smoothness, but

all the four kinds of tactile qualities in different degrees and combinations characterise aggregates of matter from the binary molecule upwards. The Jainas appear to have thought that gravity was developed in molecules as the result of atomic linking. Simple tastes are of five kinds,-bitter, pungent, astringent, acid and sweet. supposed by some to be resolvable into sweet, while others consider it as a compound taste. Smells are either pleasant or unpleasant. Mallishena notes some elementary varieties of unpleasant smell, e.g. the smell of asafeetida, ordure, etc. The simple colours are five-black, blue, red, yellow and white. Sounds may be classed as loud or faint, bass (thick) or treble (hollow), clang or articulate speech.

The most remarkable contribution of the Jainas to the atomic theory relates to their analysis of atomic linking, or the mutual attraction (or repulsion) of atoms, in the formation of molecules The question is raised in Umásvátí's Jaina Sútras (circa A. D. 40)—what constitutes atomic linking? Is mere contact (or juxtaposition) of atoms sufficient to cause linking? No distinction is here made between the forces that bind together atoms of the same Bhúta, and the chemical affinity one Bhúta to another. The Jainas hold that the different classes of elementary substances (Bhútas) are all evolved from the same primordial atoms.

The intra-atomic forces which lead to the formation of chemical compounds do not therefore differ in kind from those that explain the original linking of atoms to form molecules.

Mere juxtaposition ( कंबीन ) is insufficient ; linking of atoms or molecules must follow before a compound can be produced. The linking takes place under different conditions. Ordinarily speaking, one particle of matter (53%) must be negative, and other positive ( ( ( ( ) ); the two particles must have two peculiar opposite qualities. roughness and smoothness ( इचल and विकास or dryness and viscosity?), to make the linking possible. But no linking takes place, where the qualities, though opposed, are very defective or feeble ( जवजान ). We have seen that, ordinarily speaking, two homogeneous particles, i.e. both positive, or both negative, do not unite. This is the case where the opposed qualities are equal in intensity. But if the strength or intensity of the one is twice as great as that of the other, or exceeds that proportion, then even similar particles may be attracted towards each other. In every case, change of state in both the particles is supposed to be the result of this linking, and the plysical characters of the aggregate depend on the nature of this linking. When particles of equal intensity (negative and positive) modify each

other, there is mutual action; in cases of unequal intensity, the higher intensity transforms the lower, it being apparently thought that an influence proceeds from the higher to the lower. All changes in the qualities of atoms depend on this linking. A crude anticipation this, of the ionic theory of chemical combinations, very crude but immensely suggestive, and possibly based on the observed electrification of smooth and rough surfaces as the result of rubbing. The interpretation of und fure as dry and viscous ( or as vitreous and resinous?) must be rejected in this connection as untenable. The Tattvarthadhigama of Umásvátí, which expounds the theory, most probably dates back to the first half of the first century A. D. Cf. Umásvútí-Tattvádhigama, Chap. V.

(चनीवनाया चन्यांचन्यां आत्राज्ञपुद्धनाः। द्रव्याणि नीवाय। निन्या-विक्षितानि चन्नपाणि। कपिणः पुद्धनाः। चाकामादैकद्रव्याणि। विक्षियाणि च। पुद्दगन्ननीयासु क्रियावनः। (क्रियेति गतिकक्षांच)। सर्वेशं प्रदेशाः सन्ति चन्यम परमाणीः। संद्र्येयासंद्र्येयाय पुद्दगन्तानां। नाथीः। स्पर्यरसगन्धवर्णवनः पुद्दगन्ताः। तत्र सम्बेश्टिविधः कठिनी सदुर्गुदर्शेषुः भीत एणः सिन्धः दच दति। रसः प्रचविधिकतः कदुः कवायीद्वी मध्र दति। गन्नी दिविधः सुरमिरसुरमिष। वर्षः पञ्चविधः कर्षा नीनी लोहितः पीतः यक्र दति।

शब्दनस्वीकास्वीव्यासंस्थानभेदतमन्द्रायातपीवीतवनदः। तप शब्दः यक्षविधः तती वितती धनः यश्चिरी वर्षौ भाव यति। यक्षवः

स्क्रभाय। सर्वा च। कारचमेव तद्वा सूची निवय सर्वत परमाण्:। एकरसगन्नवर्षी दिखाई: कार्यनिकृष । ततायवीऽवदा: स्तन्नास्त वहा एव। काश्वासावत् संघातभेदीय उत्पदानी। संघातभेदादिति। इदी: परमाच्यो: संघाताद्विप्रदेश:। दिप्रदेशसाचीय संघातात् तिप्रदेश:। एवं संब्येयानाससंब्येयानासननानां पननाननानां च प्रदेशानां संघातात् प्रदेशा:। भेदादछ:। भेदादेव प्रमाणुक्तप्रवते न संघातादिति। चत्राइ। किं स्थीनमाबादैव संघाती सवति। भाडीसिद्दिस कथिइविधिय इति। भने भने भने । स्ति स्वीमे बहस्स संवाती भवतीति। सिरघरचलाइसः। न अधनागुपानाम्। सिन्ध-दचवी: पुद्रमस्वी: सप्टबीरं भी भवतीति। जधकगुणसिग्धानां लघनगुबद्धायां च परसारेय बन्धी न सबतीति। एकं भवता लक्ष्यतुष्यकांनां विज्ञानां दयेष दशायां च विज्ञान सह वसी भवतीति। यय तुल्यगुचयी: विमत्यनाप्रतिषेष इति। यदीचते। न। गुक्सामा सहमाना। गुक्सामा सति सहमाना वन्ती न सवति। लद्वया । तुल्यगुणियस्य तुल्यगुणियस्थि तुल्यगुणकणस्य तुल्यगुण-क्वेच इति। चवाच सहमयद्यं किमपेचने इति। चवीचते। गुणवेषम्ये सहमानां वश्वी भवति इति । चत्राइ किमिविशेरेण गुण-वैषये सहग्रामां वसी भवतीति। चनीचति। द्राधिकादिस्यानां तु दाधिकादिगुषामां सहयानां यन्त्री भवति । दिगुषाद्यधिकस्थित्रधेन । विगुषायधिकविगधम ग्रिम्धेन। द्वसापि विगुषायधिकदृष्ट दर्वेष । एकादिगुवाधिकशीन्त सहस्रशैवंशी न सर्वत । स्वाध परमाचुनु सत्येतु च वे सामादयी गुणासे किं न्यनस्त्रता: तेनु

भाडोखिडव्यवस्थिता इति । भनोभाते । भव्यवस्थितायुतः । परिभागत् । भवाद इयोग्यि वध्यमानयोर्नुष्यक्ते स्ति कर्य परिधामी भवति इति । स्थते । वस्ते स्ति समयुष्य समयुष्य परिषामको भवति । भविकगुषो द्योगस्थित । Umásvátí, Tattvárthádhigama, Chap. V).

The Nyáya-Vaiseshika chemical theory: a brief summary.

I must content myself here with a brief and rapid sketch of the chemistry of the Nyaya-Vaise-shika, which I shall elaborate in connection with the mechanics and physics of the ancient Hindus in a separate paper.

The relation of the specific characters of molecules (and higher aggregates) to the original
atomic qualities is reduced in the Nyáya-Viseshika
to the following canons:— (a) कार्यमुखः कारपम्यपूजेबन्। (b) समानवातीयसंगीयः द्रव्यारखनः न विज्ञातीयसंगीयः
(Here, द्रव्य is used in a narrow technical sense,
so as to exclude the quasi-compound sub-stances).
(c) चपावजकपरस्त्रअख्यापित्राचेकतीकप्रवाम्यस्त्रअख्यान्यस्त्रअख्यान्यः
सारपम्यपूजेकाः। (d) दपरस्यान्यस्यर्थयस्य परिमाणेकतीकप्रवाम्यस्यः
समानवात्वारखनः। No spearate explanation is necessary,
as the canons are embodied in the following
exposition.

## Theory of Atomic combination :-

The four kinds of Atoms are Earth, Ap, Tejas and Váyu atoms, possessed of characteristic mass, numerical unit, weight, fluidity ( or its opposite ), viscosity ( or its opposite ), velocity ( or quantity of impressed motion-Vega); also characteristic potential colour, taste, smell or touch, not produced by the chemical operation of heat wurner-६परसगस्खर्भपरिमायैकले ६-५६क-गृहत्वद्रवस्रक्षेत्रवेगाः ), A kasa has no atomic structure ( fereque ), and is absolutely inert ( fates,), being posited only as the substratum of sound, which is supposed to travel wave-like in the manifesting medium or vehicle of Váyu ( air ). Only the other four Bhutas unite (or disunite) in atomic or molecular forms. The orthodox view is that, the presence of Earth-atoms is necessary whenever chemical transformation under the operation of heat ( पाककीत्पनि ) takes place.

Atoms cannot exist in an uncombined state in Creation (Sivádityá, Sapta-padárthí—Vide commentary, where, however, it is noted that still atmospheric air is believed to be monatomic in structure, i. e. to consist of masses of atoms in a loose uncombined state—( श्विनववाद्यस्य परमायुसम्ह एव भनादब-हवा:

The atoms may combine in one or other of the following ways :--- 1. One Earth-atom, by an original tendency, unites with another, to form a binary molecule (unit). In the same way, binary molecules of the other Bhûtas are formed. The atoms are possessed of an inherent Parispanda (rotary or vibratory motion), and when they unite in pairs, so long as there is no chemical operation under the action of heat corpuscles, the original qualities of the atoms produce homogeneous qualities in the binary molecules.

The question as to the existence of a triad, a tetrad, a pentad etc. of atoms is one of the moot points of the Nyava-Vaiseshika. The orthodox view is that, the primordial infinitesimal particles ( atoms ) start with an incessant vibratory motion पनवरतपरिस्मन्द्रनानापरिनितपवनाद्विपरनायवः, Raghunátha S'iromani-गतिश्रीजलात् पतसव्यपदेशाः पतनीति, Udayana, Kusumānjali), and an inherent impulse that drives them to unite in pairs-a sort of 'monovalency', as it were, exhausted with the formation of a binary molecule. The binary molecules combine by threes, fours, fives, etc. to form larger aggregates as well as the variety of elementary substances, the particular collocation in any case being not only determined by physical causes, but also serving to satisfy the ends of the moral Law in creation ( घट्ट, कथा), ( बायुकेवंडुशिरारस्वते इत्यपि नियमी,

न दान्या। बहुव लिनयमः। बदाचित् विभिरायनते प्रति। वायुक्तिमञ्चते, बदाविवतुर्भिरारभाते बद्धावित पश्चिमिरित वदेष्टं कस्पना। चहत्त्रमान् तथा तथा तथा वर्षो यथा यथा तदारम्पेषु चपरजातयी व्यव्यक्ते। घटटकारिता सर्वभावानां सहि:। S'ridhara, Nyaya-Kandalí, पृथ्वितिकप्यम्।) Cf. Váchaspati's report, Bhámatí, Chap. II., Pada II. Sútra II. ver चतुरचन्नमारभते चतुर्या दायकानामारश्यकतात् ). Prasastapáda appears to have originated this view ( परनाणवार्क्षव बहुलसंख्या तैरारओं बागुकादिसमये-Prasastapada, परिमाय निक्पवम्); but that another view was also maintained in the Vaiseshika School is evident from the brief summary of Kanada's system given in Utpala's commentary on the Vrihatsamhita, and this indeed also follows from S'ridhara's admissions in the Kandalí. On this view, also, atoms have an inherent tendency to unite, but some unite in pairs, others in triads, others in tetrads, etc. This may happen in two ways, -either by the atoms falling into groups of threes, fours, etc. direct, or by the successive addition of one atom to each preceding aggregate.

A triad (Tryanuka ), then, holds together three atoms (Anus ), not three binary molecules (Dvyanukas) as on the orthodox hypothesis. Similarly with tetrads, pentads etc. प्राचिता प्रमाचन: चितिनवाधिना गुनाम् ।

बाध्या परमायध्या बयुक्तमारस्ति विभि: परमायभिक्षायकभारस्ति दित कमेच स्मृत्वकार्ध-इस्पसीत्पणि:। Utpala, Chap. I. S'loka 7; cf. also S'ridhara's admission, चववा यदि परमायवी वायय-मारस्य तत्वविद्यास्त्रायकमारसभे वायुक्तविद्यास्त्र इस्मृत्यस्त् तवापि कृती विश्वस्य चयुष्यम् ). S'ankara seems to speak of two binary molecules in the Vaizeshika as forming a tetrad, ( यदापि वे वायुक्त चतुरक्तमारसेत—S'áríraka-Bháshya, Chap. II, Pada Sútra, II, where the Bhámntí gives a forced interpretation ).

In Prasastapada's view, these binary molecules are grouped by threes, fours, fives etc. (बायक, चतुरक्क) to form different isomeric modifications. The variety of Earth-substances is due to differences in the arrangements of the molecules (e.g. their greater or less density, and, above all, their grouping or collocation क्ष्य, पवयवस्तिवेश), which account for the specific characters (चपरजाति) manifested by these isomeric substances. सा पृथिको च स्त्रेष्ट्रांचयवयस्तिवेशियदा पपरजातिवयुक्तिपेता। Prasastapada, प्रथिकीत्वयपम् । स्त्रेष्ट्रांचयवयस्तिविश्वयम् । स्त्रेष्ट्रांचयवयम् । स्त्रेष्ट्रांचयवयम्यवयम् । स्त्रेष्ट्रांचयवयम्यव्यवयम्यव्यवयम्यव्यवयम्यवयम्यव्यवयम्यव

र्देश्वे स्थिरता विरकासावस्थायित्रमिति यावत् । वादियद्वसादिष्टपावत्वं नसादिन्य इविरोधितस्य । ववस्वसित्रवेशाः तत्वत्सामान्यविश्रेषाभिष्यस्यकः संख्यानविश्रेषा:। न कि एतदृद्रव्यानिर संबैदित । जलादीनां गतविचित-स्त्रभेवद्वेगवदद्व्यीपनिपातमावेचेव अक्रुस्तात । Udayana, Kiranávali, ibid. These original differences in molecular grouping leading to distinctions of genera and species, however mechanically or physically explained, come also under the operation of moral and metaphysical causes ( पहर, वर्ष ), i.e., of ideal ends in the moral government of the universe, which are superimposed upon the physical order, but which do not come within the scope of Natural philosophy. An elementary substance thus produced by primary atomic combination, may, however, suffer qualitative change under the influence of heat ( पाक्कोनपनि ). The process is as follows :- (1) the impact of heat corpuscles decomposes the binary (tertiary, or quaternary) molecules into homogeneous atoms possessing only the generic characters of the Bhuta concerned ;-(2) the impacts of heat particles continue, and transform the characters of the atoms; determining them all in the same way ;-(3) the heat particles continue to impinge, and reunite the atoms so transformed to form binary ( or other ) molecules, in different orders or arrangements, which account for the specific characters or qualities finally produced. The Vaiseshika holds that there is decomposition into

homogeneous atoms, transformation of atomic qualities, and finally recombination, all under the influence of heat. The Nyaya on the other hand thinks that the molecules and larger aggregates assume the new characters under the influence of heat without decomposition into homogeneous atoms, or change of atomic characters (fuggra or fuzzara).

तेषामतुमानेन विनाम: परिकल्पते। सर्व्यावस्थेषु धनावैद्विस पातपूर्वकपूर्वकपादिविकचचगुणीपलव्धरनः प्रवितः स्थानीरनुमीयते तेन वेगवता वहिद्रैस्येच नीदनात् कमियातात् वा नृतं घटाधारक्षकेषु चनवनेषु किया लायते कियाती निभागः निभागात द्रव्यारमासस्योग-विनाश:। तरिनाशात् द्रस्यविनाश:। प्रकाय श्रामादिगुवानवज्ञहत: रक्षादिनुषान्तरवीनमनुभवनः — षह्टप्रर्थमायाः परलरं संयुव्य दाएकादि-वकसेय ताइम्मेन भटादिकार मारभने। एवं तपनातपढम्मनानेषु पासादिकतीयु एव एव नाय: शरीरे पपि छड्खेंच तेजसा पण्डमानेषु पनपानादिष् रसमलधातुभावेन परिचाममुपगच्छत्स प्रायेच प्रतिचय-मुतपाद्विनाची संभवत प्रति । ( Jayanta, Nyáyamáñjarí भूतचेतन पूर्वपच ). This is the Vaiseshika view, but Jayanta himself inclines to the opposite view :-प्रकारसंबिरतधैव कार्यद्रव्यस्य घटाई: चारमात् चनासेत्र:कचानुप्रवेज्ञकत-पाकीपपत्ते: चर्ल विनामकरपत्रया । पिटरपाकपत्र एव पेयल: । ibid. The Nyáya view:—ये बीत्रावयवाक्षे पूर्वेम्ब इपरित्यारीन

न्य कान्यसायको स्व कान्यस्य । च वृष्टिकी धातुरवृष्टातृता संग्रहीतः चान्यरेच तृजसा प्रचानो रसद्रव्यं निर्वत्यं सित स्र रसः पृष्टां व्यवस्थितो । इत्याद्यस्थानि बीजानि स्वन्धीत्येततः प्रतिपद्याम् । विद्यास्य स्वाद्यास्य स्वाद्य स्वा

- 11. Chemical combination ( सभ्यक्तिया, संस्तिक्या ). Chemical combination takes place either between two or more substances which are isomeric modifications of the same Bhüta, or between substances which are modes of different Bhütas.
  - A. Mono-Bhautic compounds. The simplest compounds are Mono-Bhautic compounds, i. e. compounds of different substances which are isomeric modes of the same Bhuts.
  - (a) Mono-Bhautic compounds of the first order:—Under the impact or impulse ( মনিমান or নাহন) of heat corpuscles, the substances in chemical contact ( মান্মান ন্যান) break up into their atoms. These atoms are homogeneous, possessing only the original physical and chemical characters of the Bhúta concerned. As the speci-

fic differences between isomeric substances arise from the arrangement or collocation of the atoms, the substances lose their distinctive marks on decomposition into the latter. (न च परमाणुषु पपरजातिमेदी विद्यते न च यववी ज्ञासिवी लपरमा गुनां कविद्विशेषः । Uddyotakara, Chap. III, A'hnika I, Sútra 4. न च शक्रमीचितपरमाचुना कविद-विशेष: पार्थिकाविशेषात् । S'ridhara, Nyaya-Kandali, पृथ्य निष्युष्य )। Under the continued impact, ( or, it may be, impulse ) of heat particles ( देनवता वीच-दब्येच नीदनात् चालघातात् वा-Jayanta ). these atoms take on new chargeters. It is heat and heat alone that can cause this transformation of the colours, tastes, smells, etc., in these original Bhuta-atoms. What particular colours, tastes, smells or physical characters will be produced in the atoms depends (1) on the nature of the constituent substances in contact, (2) the intensity or degree of the heat ( खर, सदु or मध्यम पाक ), and (3) the species of Tejas-corpuscles

the impinge on the atoms, or the nature of the impact ( विल्वचतेलः-संयोग). (न इमीऽप्रिसंयोगात् एककात् ब्यादय दित भीप तु पूर्वब्यादिविश्रेवायेचात्। यददव्यं पच्यते भीमसंयोगेन तक्ष ये प्रवंब्यादयस्योग यः सगतो विश्वकमयेचनायः भिष्ठदंशीतः चत्तरात् ब्यादीन् विशिष्टानारभते। Vide also Uddyo takara III, 2, Sútra 14. Cf. also Váchaspati, I, 1, Sútra 4. भणाकमध्ये भिष्ठ स्थादास्य विद्यस्य भौभापराञ्चस च विष्ठसंयोगस्य पूर्वब्यादिक्ष्यंसानां कारणानां भेदात् भिष्ठजातीया सायल गणव्यस्यस्य दिव्यानः)।

Now when the atoms have all been determined in the same way, they begin to recombine again under the impact (or impulse) of the heat-particles in binary molecules, (or tertiary, etc.), and these in higher aggregates. It seems to be generally held that, at the final step one or more atoms of one constituent substance unite with one or more atoms of the other constituent substance or substances to form a molecule of the com-

pound; but the question is not of much significance for Mono-Bhautic compounds of the first order, as, in these cases, the atoms have before this all lost their distinctive characters and become homogeneously transformed. The compound so produced will possess the new characters of the transformed atoms, so far as taste, colour, smell, etc. are concerned, but as the molecular arrangement or structure ( \*\*T, \*\*\*Q\*\*Q\*\*Q\*\*Q\*\*T\*\*) may vary, different compound substances may result from the same components.

(b) Mono-Bhautic compounds of higher orders:—Again, Mono-Bhautic compounds of the first order may chemically combine to form higher compounds, and as the ultimate Bhúta substratum is the same, the process of decomposition and recomposition will be essentially the same as before. The only doubtful point is whether in this case the component compound substances are broken up only into their constituent molecules, or into the original homogeneous Bhûta atoms. Some of the later Vaiseshika Scho-

liasts hold that the latter happens in every case of chemical composition, however complex, but the Vaiseshika conceived that in the case of compounds of compounds, the decomposition does not proceed so far as the original Bhuta atoms ; but that it is the specifically determined atoms constituting the molecules of the component compounds that are transformed under the impact of the heat-corpuscles; and then one such transformed atom ( one or more according to another version ) from the molecule of one component unites with one similarly transformed atom (one or more according to the other version) from the melecule of the other component. Prasastapada, the great Vaiseshika Doctor, holds this view. When, for example, in the fertilised ovum, the germ and the sperm substances, which, in the Vaiseshika view, are both isomeric modes of Earth ( with accompaniments of Bhútas), unite, both are broken up into homogeneous Earth-atoms, and it is these that chemically combine under the animal heat ( and bio motor

Energy, and ) to form the germ-plasm ( कवव ). But, next, when the germplasm develops, deriving its nutrition from the chyle ( blood ) of the mother, the animal heat breaks up the molecules of the germ-plasm into its constituent atoms ( কৰলাংখক-परमाण्य: ). i.e., into atoms specifically determined, which by their grouping formed the germ-plasm, and then these germ-plasm atoms as radicals chemically combine with the atoms of the food constituents, and thus produce cells and tissues. (समृत्पन्नपानके: कलका-रक्षकपरमास्थिः चहत्रवात् उपकारकि वै: चाडारपरमाय्भिः सड समूब प्रशेरान्तरमारभाते इत्येषा कस्पना। पितुः ग्रकं मातः श्रीचितं तथीः स्तिपातानलरं जठरानलसम्बस्तात् ग्रह्मशैदितारक्षकेषु परमाख्य प्रमेद्दशदिविनामे सति समानगुपानारीत्वती दाचकादि प्रक्रमेण कललग्ररीरोत्पणिः। ...तव मानुराश्वाररतः मावया संकामति घटट बन्नात् पुनर्जंडरानसम्बन्धात कललारधाकपरमायव् क्रियाविभागादिन्यायेन कलक्ष्यरीर नर्ट समृत्यव्रशाकनै: कडलारककपरमाण्भिः घटण्यमात् छपत्रातकियः

बाह्यस्याग्भिः वह सक्षत्र प्रशेरान्तरमार्थते प्रतेषा कलागा। S'ridhara, Kandalí, पृथिवीनिकपणमा) In this hypothesis ( अल्पना ), it is assumed that the atoms are similarly transformed, i.e., become endowed with the colour, taste, smell, etc. of the product (the cell or tissue ), the moment before the chemical combination takes place. Similarly, when milk is transformed into curd, one view is that the transformation takes place (under internal heat ) in the constituent atoms of the milk molecules, atoms specifically determined as milk, and not in the original atoms of the Bhúta (or Bhútas) entering into composition of milk. एवं महादुरधारयकी: परमाक्षिरिव दध्या-रभ्यते । एक महिस्त व दध्यारमाकेरेव धर-माण्भिनेतकीतारमः पति दिक्। Nyáyabodhini, on Annam Bhatta's Tarkasangraha. ) Cf. Dinakari, on the other hand-हाण्कदपदुग्धनं सन्नवारेऽपि तसा (दध:)।) In these cases, the atomic contact is called constituent contact

- (चारकसंवीन), and all the atoms are equally regarded as material causes (उपादानकारच or समयाविकारच) of the compound.
- В. Hetero-Bhautic 'quasi-compounds' .-Nyaya-Vaiseshika maintains that in the case of bi-Bhautic (or poly-Bhautic ) compounds, which are only quasi-compounds, there is another kind of contact between the hoterogeneous atoms of the different Bhutas. which may be called dynamic contact and is distinguished in its operations as Upashtambha, Vishtambha or Avashtambha ( स्पष्टक, विष्टका or अवस्त्र ). In some cases, it so happens that the atoms of different isomeric modes of the same . Bhûts do not chemically combine under the mere application of heat ;they require to be surrounded (and 'excited', 'energised') by atoms of different Bhútas. For example, in the case of the oils and fats as well as of plant saps and fruit juices the Earth-atoms must be dissolved in water ( Ap ), and it is only when the water atoms (Ap-atoms) congregate round the former that dynamic intra-atomic

forces are set up, and the Earth-atoms (with the water atoms in dynamic contact) now take on peculiar infra-sensible characters ( colours, tastes, smells) under the impact of the heat corpuscles, and then, under further impact, fall into groupings or collocations ( of a very peculiar nature, to be presently explained) which determine the nature of the compositite substance thus produced. Here it is the waterstoms that are dynamic ( उपस्था ). and excite the Earth-atoms, and these substances, oils and fats ( तेलुका and इतवर्ग ), as well as acids ( प्रवान ) are. because of the Earth radicles regarded as Earth-compounds (or Earthsubtances ). ( पाकज-तथाविधगन्धरसद्यादिसाँह: परमाणभिद्याणकादिक्षमेण प्रतादिद्रन्यमारस्यते । तव उपष्टमाकतया निमित्ततामापद्माः पानीयावयदाः । तेषां संयुक्तसम्बाधन खेइसबीपलभ्यते। तैसचीरादिव पार्थिवलसिवि:। नेलस भीमानविश्वनलात् एतवत्। Udayana ). In the above instances, Ap ( water ) acts as dynamic ( Upashtambhaka, ( उपस्थक ), but Tejas

and Vayu can also act in the same way on Earth-particles. Conversely, Earth-particles may act dynamically on the atoms of the other Bhutas, For example, in the case of mercury and the metals which are conceived in the Nyaya-Vaiseshika to be igneous bodies (in fact they are supposed to be formed under the subterranean heat wints ), the Tejas corpuscles are believed to form the radicles, and the Earth-particles are dynamic ( उपरचक ). ( सुवर्षोदि निरन्तरं भाषनानमपि न पर्वेडपं जहाति। तमेव द्रव्यान्तरेष प्रतिवद्धवात् उपस्थाकीऽपि पार्थिव-भाग: सहप्रदय प्यानुवर्शते, यश पुटपाकादिना रक्रमारता दृश्यते तन्त्रिदीभृताभिभावकतचदृद्रयोप-गमात्। एतेन पारदादि व्याख्यातत्। Udayana, Kiranávalí, तेज्ञीनिष्ययम्। Cf. also चीऽपि तेजसमिन्द्रति सुरचे तिनायत पार्चित्री भाग छपष्टका एष्ट्यः । )

It may be here noted that Gangesa, the author of the Tattvachintamani, conjectures that even gold can be evaporated or made to disappear by the application of intense heat; चय दुतदुततरादिः क्रमणः प्रतीतेः प्रयज्ञानज्ञ-संयोगिन स्वर्धनामात् तददवता नद्यति। But Mathuránátha notes here—भव्यभाक्काजो-च्छेदसम्यो। (स्विकर्षवादरहस्य).

But while every Bhuta can act dynamically as उपस्थात 'energiser'. 'exciter', it is the Earth-Bhuta alone which is capable of exercising the power of arrest or inhibition of molecular motion or the motion of particles due to gravity as in fluids ( Vishtambha, fava ), or the power of counteracting the tendency in a given set of atoms to fall into a peculiar order or group ( ब इविरोधितम् ), (न च पार्थिय्वत चमी द्रव्यान्तरं बच्छदिष्टक्षाति पूर्वव्या च विषयि । Udayana, Kira-%ivali, पृथिनीनिक्यचम्। विषयकलं साभा-विकयुक्तायबद्रव्यानस्यतिवतिवस्यक्तम् । व्युक्तिरोधिलं च साभाविकनुदलवन्पतनः तिवसकत्म । Vardhamána, Kiranávalíprakása, ibid.)

Oils, fats, milks—Bi-bhautic quasi-compounds, with Ap as energiser:—Oleaginous substances (पाञ्चतेषादय: संचा: ) are divided by Udayana into (1) oils, derived from vegetables, (2) butters derived from milk, and (3) fats derived from animals. The medical schools, as we have seen, recognise animal oils as distinguished from vegetable oils. Vegetable fats (e.g. fawaya ) are also mentioned. Váchaspati in the Tátparyyatíká contends that mustard oil has not the flavour and smell characteristic of the true oils ( sesamum, linseed etc. ), and is classed with the latter by convention. Judged by the flavour test, A'miksha (the casein substance formed by mixing milkcurd with hot boiled milk ) is to be classed with milk substances. So also Takra, whey,but Vájina, the thin fluid that is left after the Am'ikshá (casein substance) is separated, cannot be classed as milk. It may be added that the milks and curds as well as oils and fats derived from different species of vegetables or animals are supposed to differ in their ultimate structural arrangement and therefore in kind; but Vallabha thinks that the ghees (clarified butters) prepared from different kinds of milk are of the same kind, in other words, the milks and curds are 'polymeric', the ghees (clarified butters ), 'isomeric', using these terms, as before, in a loose general sense.... तेसप्तवसानां बोलकोर-मांचयोनितात्। चतएव नारिकेलखेडसापि तेलतं रसादि-

सःख्यादिष तु एतव्यपदेशसः। Udayana, Kiramivali, पृथ्वितेनिक्यसम्। Vallabha notes that ghees do not differ in kind, as milks (and curds) do:— भती माहिषयव्यादिदृत्वेषु दांधलवन् एतादिषु जातिमेद-एवालामिति चेत्र।— Vallabha, Lilávati. Compare Váchaspati, II, 2, 65:— मान्यतैसादीनां जातिस्तु मध्येन वा रसन वा व्यव्यते। भत्यव न सार्वपादीनां तैसलमिस। तदासकयी-विध्यायादान्। भाकस्तु वेस्वय्य्यीयः। चीरजातिर्प रवव्यक्षेत्रः। भत्रस्यीरभावान्। भाकस्तु वेस्वय्य्यीयः। चीरजातिर्प रवव्यक्षेत्रः। भत्रस्यीरभावान्। भाकस्तु वेस्वय्य्यीयः। चीरजातिर्प रवव्यक्षेत्रस्य वाजिनस्य तद्व्यक्षकस्य रस्नीदस्य वाजिनस्य तद्व्यक्षकस्य रस्नीदस्य वाजिनस्य तद्व्यक्षकस्य रस्नीदस्य वाजिने भभावान् मानिकायां स्थावान्।

III. Mixtures like soups, solutions etc :- A soup is a physical mixture of a peculiar kind, from which evaporation ordinarily sets the water free (cf. Udayana's चन्दीतमुक्त infra ). When meat is boiled in water, there is the application of heat, with chemical changes in the meat, but the combination of meat-particles and water-particles in the soup is only physical combination, and not a chemical one. It is of course not a true compound, neither is it a quasi-compound, like milk (in which the waterparticles are 'energisers' of the Earth-particles ). Milk, for example, retains its milky substance, when it coagulates or becomes solid, (this of course is also the case with mono-Bhautic substances whether elementary or compound, e. g. water, which becomes ice,) but the substance we call a soup or solution ceases to be a soup

or solution, the moment it solidifies. Uddyotakara notices gruel, baths, and lyes (alkaline solutions) as mixtures of this class ( एतेन पापकाश्चिकविवेकावचाराद्य: प्रवाहा: 1 Várttika, Chap. I, A'hnika 1, Sútra 14). डि नाम उत्पन्नपाकतानां द्रव्याचां कालविशेषातुबद्धे स्रति ह्यालरसंप्रकानां पाकजीत्यकौ यः संयोगः स ब्य प्रति। एतेन पाककाञ्चिकविवेकावचारादयः प्रवाहाः । Uddyotakara, Varttika, Chap. I. A'hnika 1, Sútra 14. Vide also Váchaspati's comment : जन्दनपाकनानां तेले सर्पिष वा पिष्टमांस-विच्छावयवानां द्रव्यानरिय तीयेन संयुक्तानां वाकशीत्पत्ती सन्तां न चासी सहसा इल्र्इं कालविश्रेषातुरहे सतीति। स च संबीतिनेद-एव तीयमांस्यीनंतु चवयवी विकासीययीरनारचकलात्। नापि वृषजातीयं तीयसंथीति इन्यं चौरजातीयभिवेति यक्तमः। तीयविरहे चाहिन्देऽपि चीरबुडिव्यपदेशकीसादवस्थात्। इह तु काठिने न व्यवहृदिव्यपदेशौ इति सन्वभीद प्रतीयमास्योर्ध्य इति न्याव्यम् । स च चतुभवस्दिः संयोगिव्यतिरिक्त:। Váchaspati, Tátparyyatíká, ibid. For salt and alkaline solutions, vide Kiranávali-17 पुनरम्बुधिसिन्धमेदिन चारादिरपि रसः पावसे स्पलस्थते स दममूलकषायस्थेव पार्धिवद्रस्वीपाधिकः। कदमनाया तस्थैव चनपीतसृजस्य रसी मधुर एव । Udayana, Kiranávalí, जलनिकप्यम्।

Chemical action and Heat:—The operation of heat is of course universally implied in chemical

combinations. Where the application of external heat is wanting, Vátsyáyana, the great Doctor of the Nyaya, points to the operation of internal heat. (e.g. पृथिबीधात: चयधातुना संग्रहीत: चानरिक तैलासा पचानान. रसहण' निवेत्तंयति ।- Vátsyávana-Bháshva, Chap. 1V, A'haika 1, Sútra 47). In the case of combustion, we have seen Vijnana-bhikshu explain the heat as latent in the Earth-substance, the fuel, from which it breaks forth. Udayana points out that the solar heat is the source of all the stores of heat required for chemical change in the world. The change of colours in grasses, for example, is due to Tejas, in the form of latent (invisible) heat, not in the form of Agni; and the cold in winter cannot take away this store derived from the San. ( अषादिविकारी दि यदि द्यादिवराशीन-मायदेतुः स नम्मीयापियेय तेजसा कर्मवाः। ताहवे च पाने पनिमनं डिममिति। न किथिदनिष्टमाप्यते। न डि सीरस तेजमः बेलीकापाकहेतीर्शिमादपगमः चमते। चय विकारी भव्यादिकपी विविधित: सीऽसित एव डिमड्तेष तथादिष क विरीधी वाधी वा। द्यादिपराइत्तिमावेकैंव चित्रः साध्यते तदशकाम् । दर्भनसम्बन्धान्त्रस्य योग्यानुपसम्बन्धानितलात् भताहतस्य तेजीमावस्य निहत्तेरप्रकालात् चनिष्टलात् च। Udayana, Kiranávalí वृष्टिसंदार[वृद्धि[वृद्धवयम् । ) Similarly, it is under this solar heat that the unripe mango ripens, i.e. changes

colour, taste, smell etc., showing that there is chemical transformation or subtile decomposition and recomposition going on; and this is also the case with the rusting of the metals, which is a combustion due to the solar heat ( म्योपाझ ) even as the conversion of food into chyle and of chyle into blood are instances of chemical action due to the internal animal heat ( जहरानल or भीदये तेज: ). But the kind of contact with heat-corpuscles, in other words, the kind of chemical action ( पाक ) which transforms colours is supposed to differ from that which transforms flavour (विजयपतेन:संयोग) and पाक ) and this last from that which produces a change of smell, or tactile quality, ( पाको नाम विजातीयतेन:संधीन:। स च नानाजातीय:। इपजनकी विजातीय-तेज:संयोग सदपेचया रसजनको विजातीय:। एवं स्प्रशादी चिव तथा। एवंद्रकारेण भित्रभित्रजातीयाः पाकाः वार्थवं मचक्छेन कसमीयाः। तयाचि वयपुचनियादयादौ उचलचयवित्रातीयतेत्रःसंयीगात् पूर्व-इरित्रहपनाश्रहपान्तरसा पीतादेवत्पत्तिः पृथ्वेरससा श्रमस्रोदानुभवात । कचित् पूर्वहरितद्वयश्चेऽपि रसपरात्तिह स्ति विजातीयतेज:संबीय-कपराखवनात् पूर्वतनासरसनामे मधुररससानुभवात्। तसाह्य-लनकापेचया रसजनकी विश्वचय एवं बन्धजनकी विश्वचया एवाक्रीकार्यः कपरसयीरपराहती पपि पूर्वनश्वनात्री विजातीयपाक-नमात् सुरक्षिगश्रीयस्थः। एवं सर्भजनकीऽपि पाक्रवशात् कठिन-

स्पर्यनात्रे सदुस्प्रजातुभवात्। यतएव पार्धिवपरमायुनामेकजातीयत्वेऽपि पाकमिक्ता विकातीयद्रस्थान्तरानुभवः। यथा गीभकात्वादीनां भापर-मार्फलं सक्के उत्पारक्षकपरमायुक् विजातीयतेज:संबीगवद्यात पर्व-तदनकरं दक्षे बाह्यं वर्धते ब्यादिचतुष्ट्यनाशे **ब**पादिकं तादशब्दरसगन्धस्य श्रीजनकाक्षेत्र:संशीमा जायनी। तदत्तरं तादशब्दादय उत्तपदली । ताहत्रद्वपदिविशिष्टपरमायुभिर्दं व्यदायुक्तमार्थ्यते । वायकादिक्रमेण महादृत्यारच प्रति ! Nyáyabodhiní Annam Bhatta's Tarkasangraha ), Heat and light rays are supposed to consist of indefinitely small particles which dart forth or radiate in all directions rectilineally with a sort of conical dispersion and with inconceivable velocity. They may either (1) penetrate through inter-atomic (or inter-molecular) spaces as in cases of conduction of heat which when applied under the pot boils the water, or fries the paddy where there is no chemical action in the pot, no decomposition and recomposition of its atoms, no change in the molecular collocation ; or, as with light rays in cases "of translucency or transparency ( सम्बदा ) penetrate through the inter-atomic spaces with Parispanda of the nature of deflection or refraction (तियंग्रमन, Udyotakara), in the same way as when fluids penetrate through porous bodies (तच परिसाद: तिव्यंग्गमनं परिसव: पात इति-Udyotakara, commenting on Vátsyáyaná's परिस्थन्द-परिवादी, Sútra 47, A'hnika 1, Chap. III.) or (2) impinge on the atoms, and rebound back-which explains reflection ( मृच्छ न, किरपविषद्दन-Varábamihira, राज्यस्यावर्णन-Vatsyavana) or otherwise be obstructed by the atoms in their path, which would explain degrees of opacity, the casting of shadows, etc., all these operations being also physical, and unattended with decomposition and recomposition or alteration of molecular grouping, or (3) lastly, strike the atoms in a peculiar way, so as to break up their grouping, transform the physico-chemical characters of the atoms, and again recombine them, all by means of continual impact with inconceivable velocity, an operation which explains all cases of chemical combination. (६ चिन्यो डि तेजसी चायवातिमयीन वेगातिमय: थत् प्राचीना चलचुड़ावलस्थिति एव भगवति मयुखमालिति भवतीदरेषु चालीकः स्वांत्रमानी लीकिकानाम्। (Udyana, Kiranávalí, तेजीनिकप्यम -taken from Váchaspati, Tátparyyatíká, учч-खबब बचन ।) Cf. also (चायुर्व तेज: वेगवता सावितेन वैज्ञसा न प्रतिष्ठन्यते । Váchaspati-बर्ल्टिशे पिक्कितमपि तेज: प्रसर्पत् प्रासादीदरं व्याप्रीति। तत् कस देती: पृष्यग्रवात्। प्रसरद्वि न स्वपरिमाणानुविधायिन प्रव्ययमाधत्ते किं च विषयभेदानुविधायिनम्। ibid, Cf. स्कटिकायान्तरितीपस्तिअरिप

प्रसादस्य मावस्या स्कृष्टिकादीनां तेजोगतेरम् तिवस्यकत्या पदीपम्भावा-देवीपवदाः Udayana, तेजीनिद्यवस्, in reply to the objection—पदि हि प्राण रहीयात् प्रतिघातिना काटिकद्रशेष विष्टभादमामं प्रसर्पेन्यादिकं नाददीत तकादमापन्नकारि तती न तैत्रसम्। (Udayana, ibid.) Definition of सन्धता-द्रवालरासन्पृष्ठद्रव्यसम्बायः श्रन्कता । इष्टयाप्रतिघातः काचास-पटलस्कटिकार्नारतीपलथे:। ... स्थास्थादिषु च पाचकसा त्रवहाद्वातात्। Uddyotakara, Chap. III, A'hnika 1, Sútra 38. थाड्स्ट्रिंग्स: स्प्रिटकानिरितेऽपि डाचोऽवि-चातात् । Sútra 47, where Uddyotakara notes-कोइय-मिष्यात:--यस द्रव्यसायया न व्यक्तने तस दलरावयवं: चव्यक्रमानक योऽभिसम्बन्धः सोऽविधात इति। Váchaspati explains यस द्रव्यस अर्थनकपालाई: श्रव्यता न व्यक्तने पूर्व्यात्मक्रस्थीमनाभेन द्रवान्तरजनक्रसंथीगीत्पादनं व्युद्धनं क्रियनो तथ द्रव्यस भर्जनकपालादेश्यासानस चनरावयवेवींऽभित्रस्थी वह: सोऽवितचात:। Cf. Vátsyáyana on Sútra 47, A'hnika 1, Chap. III. On the other hand in chemical combination, we star; क्रमानीरनुसीयते। तेन वेगवता बक्रिट्रव्येष नीटनात चिन-घातात् वा चव यवेषु क्रिया, क्रियाती विभागः, विभागात् चारकसंयीगविनाम: etc.-Jayanta, Manjari, भूतचेतन्त्र-पुनेपच। For opacity, shadows, etc., vide छावा त तेज:परमाचीरावरचात् मूर्त्तिमता परमाचना तेज:परमाच-रात्रियते। यत च चस्र चावरयं तच च्हादेति। विरत्त-तेज:सम्बनीत द्रव्ययुगकर्नाचि च्हाया द्रव्यक्षिपीयते। सर्वाती साहचतेत्र:सम्बन्धीन तु वानि तम:संश्रकानि। Uddyotakara, Chap. IV. A'hnika 2, Sútra 25. For reflection, and its laws, I quote passages in my paper on Hindu Physics and Mechanics, to which the student of the history of Optics is referred.

Arrangement of atoms in Space:-The Nyáya conceives atomic magnitudes as Párimándalya, a term which indicates a spherical shape. ( निन्त परि-मखलम्-परिमञ्ज्लमेव पारिमाखल्यम्-Sankaramisra). in space, Váchaspati takes conceive position three axes, one proceeding from the point of sunrise in the horizon to that of sunset on any particular day \ ( roughly speaking, from the East to the West) ;-a second bisecting this line at right angles on the horizontal plane, (roughly speaking, from the North to the South ), and the third proceeding from the point of their section up to the meridian position of the sun on that day, (roughly speaking, up and down ). The position of any point in Space, relatively to another point, may now be given by measuring distances along these three directions, i.e. by arranging in a numerical series the intervening points of contact, the less magnitude or distance being that which comes earlier in this series, and the greater that which comes later. The position of any single atom in Space with reference to another may be indicated in this

way with reference to the three axes. But this gives only a geometrical analysis of the conception of three-dimensioned Space, though it must be admitted in all fairness that by dint of clear thinking it anticipates in a rudimentary manner not only the foundations of solid (co-ordinate) geometry, but also of the geometry of position, and especially the conception of Space as a Manifold, which alone can serve as the basis of a generalisation comprehending all different possible kinds of geometry, Euclidean and non-Euclidean. (पकले प्रिया: चाहित्योदयर प्रपत्या र बर्दे प्रश्या की यः स दतरकाद्विप्रक्रष्टपदेशसंबीगात् परमाणीः पुर्कः एवमादि-सासमयदीम्बनास्त्रदीयसंयती यः दुगरसादविप्रक्र एटीय-44 संयोगात परमाची: पश्चम: तौ च पुर्श्वपिशमी सर्वोदयास मय देशविश्र सर्देशसंधी गः वर्ती। एवमेत्रशेवीं तिर्वगरीयसम्बन्धी सध्यस व्यवस्थिती पार्श्वर्शनंती ती दशियोगरी परमाण । सक्यन्तिनवर्शिसयां सञ्जिक्षविशक्षवी चपेला **चपर्यश्रीभावी** द्रष्ट्यः। संयुक्तसंबीमान्यत्रस्यस्ते च सदिकर्वेनिष्ठकर्वी पूर्ण-संख्याविकात्रलं च कल्पलं परसंख्याविकात्रलं च स्थलस्। Váchaspati, Tátparyyatíká, Chap. IV. A'hnika 2, Sútra 25.

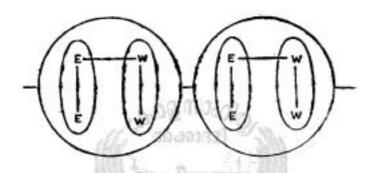
The original physical arrangement of atoms is also given. Each atom is in contact with six other atoms, which gives a cubical arrangement. 44 दिशोऽपि एकस्या चपि संयोगा एव भागा: सीऽयं परमाणी: यहकैन युगपदयोगी मूर्चलमावप्रयुक्त: न सावयवसप्रयुक्त:। ibid. Cf. also the objection in the Buddhist Karika. व्यक्तन युगपदयोगि परमाणी: पर्वमता। वर्षा समानदीयले पिण्ड: स्वादणमावक:॥ This is the typical primordial arrangement, and variations in the collocation of atoms and molecules (यह, प्रवयवस्त्रिवेश). as we have seen, were conceived to account for the variety of isomeric modes of the same Bhúta. as well as of mono-Bhautic and poly-Bhautic compounds.

The molecular arrangement in the case of bi-Bhautic compounds is very peculiar. Two substances, say Earth and Ap ( water ), form a quasicompound, first, and each substance breaks up into atoms, one atom of Earth comes into contact with one of Ap. But the two do not form a binary molecule, Instead, this contact of heterogeneous atoms leads to a curious result. The atom of Earth combines with a neighbouring atom of its own class, and forms a binary molecule, Simultaneously the atom of Ap combines with another Ap-atom. and forms a binary molecule. Now the first binary molecule links on to the atom of Ap, and similarly the second binary molecule links on to the atom of Earth. The moment after, the two binary molecules take on the physico-

chemical characters of Earth and Ap respectively, and simultaneously with the assumption of these physico-chemical characters, the binary molecules enter into complex contact ( संयोगज संयोग ). In all this process, work is done only in the first instant, in the contact of an atom of Earth with one of Ap-the resulting contacts, of atom with binary molecule and of the binary molecules with each other, involve no further expendition of Energy. Thus we get a particle holding two binary molecules ( of Earth and Ap respectively ) in complex contact, and such particles continue to be formed. In this way the particles of the two substances arrange themselves, and the peculiarity of this molecular arrangement explains the resulting mixed or compound qualities of this class of quasi-compounds. (संयोगजन्त संयोग:) उत्पन्नमायस्य चिरीत्पत्रस निकियस कारवरंशीतिकारचः कारका-नारवसंयीवपूर्वकः कार्याकार्यंत्रतः संयीगः ।......एक-काम दरीकृतपणि: कदम । यदा पार्थिकाणधीरखी: संबीते पार्टिवेश पार्टिक्स चलेन चाष्यस्य युनपक्षंयोगो भवतसदा ताभ्या संयोगाधा पाणि-वायुके युगपदारभीते। तती यकिन काली दायकथी: कारवगुषपूर्वक्रमेष ६पाद्यास: तकिहेव कारचाकारचगतात् संबीगात् इतरितरकार्व्याकार्थगती संबीगी युगप-दुत्पर्यते। वि कारयम्। कारयसंथीतिना डि पवारयेन कार्थे भवमां संयुक्तते इति नाय:। भत: पार्धिनं दाकृकं कारवार्धशीवना

भाषीन चयुना समध्यते । भाषामपि दागाकं कारचसंशीनिना पार्थिनेति ( Prasastapáda-Bhásbya, गुचराये संशोगनिद्यणम् । )

The whole process may be graphically represented as follows:—



E = an atom of Earth.
W = an atom of water (Ap).
E
! = a binary molecule
of Earth.
W
a binary molecule
of water (Ap).

Molecules of a bi-Bhautic quasi-compound;—graphic formula of complex contact.

I will conclude this account of ancient (and mediaval) Hindu chemistry with a note on the conception of molecular (atomic) motion, Parispanda, and the different varieties of such motion which were conceived to account for the physical phenomena of sound, light and heat. Any attempt to differentiate rigidly between Mechanics and

Physics on the one hand and Chemistry on the other at this primitive stage would be an idle affectation. My paper on Hindu Mechanics and Physics will give a detailed exposition in a separate treatise.

Parispanda: - Resolution of all physical action into motion: -

Parispanda sometimes stands for motion molar as well as molecular, but more often for the subtile motion of atoms or molecules. The radical meaning of the term is whirling or rotary motion, a circling motion, but it may also include simple harmonic motion (e. g. vibration). All setion, operation, work (fast wrust) is ultimately traced to this form of subtle motion lodged in the atoms or in the matter-stuff. The Vedanta, for example, speaks of a cosmic vibratory motion (स्थंसीक-परिस्पन्तम् - Sankara). - A kasa, in the Vedanta, as we have seen, is the first stadium in the evolution of Matter, which gives off Vayu, which gives off Tejas, and so on ; but A'kasa (Ether) itself passes through two stages before the emanation of the Súkshmabhúta Váyu :- (1) the motionless ubiquitous primordial matter-stuff (answering to the Sánkhya Bhútádi) called Puránam kham ( प्राच च ) and (2) a subtile integration, the pure unquintuplicated Sükshmabhúta called Váyuram Kham

( अपूर्व को ) ( answering to the Sankhya Tanmatra stage ). It is this subtile A'kisa, in its Tanmatric integration, i. e. in the derivative form, which is subject to an incessant Parispanda. The gaseous stage of matter (the Vedántic Váyu) is indeed matter in a state of Parispandic motion (बाबी: परिकान्द्राव्यकत्रवान-Sankara): So also the biomotor and sensori-motor principles apart from the directive Intelligence of the Self ( प्राचल परिस्थन्दा-अकलादेव-धरशैतम् सालं मुक्का ततसलं मन:स्वन्दितमायम-Sankara ). The Sankhya also conceives this Parispanda to characterise every process and phenomenon of cosmic evolution ( का सकियं परि-- 444-Vachaspati, Kaumudi). Bhutas, organisms, mental organs, as modes of Prakriti (considered apart from the Intelligence of Purusha) are all subject to this Parispanda बुद्धादया देख सकति वैद्यानरं उपाददते इति तेषां परिसन्दः। प्रशेरप्राचनादीनां च परिसान्तः प्रशास्त्र प्रशास्त्र Váchaspati on Káriká 10 ). On the other hand, Prakrati as the Avykta, the a-cosmic, the un-manifest ground, with resolution only of like to like (wzauftwa), is devoid of all Parispandic motion ( वर्षाप कवासापि परिवासकवा क्रिया, तथापि परिस्पन्दो नाचि । ibid. on Káriká 10 ). The Nyaya-Vaiseshika finds Parispanda in all

forms of matter, except A'kasa which, in that system, is non-atomic and incapable of any change or activity ( fafag ). But all atoms from those of Váyu downwards, are in incessant motion. The world at bottom is an infinitude of continually whirling (or vibratory) particles ( wastruftees-मानापरिमितपवनादिवरमाचव:—Raghunátha :—compare also Udayana-Kusumáñjali, Stavaka V.—परमायमः रि गतिभीललात पत्रबच्चपरियाः पतनीति । ). All physical action consists in motion. The Nyaya-Vaiseshika rejects force, power, operation ( mfm ) except as modes of motion. Jayanta indeed states : we do not acknowledge any mysterious power or operation, which the senses do not and cannot report to us. But this denial of Force ( ufm ) and of unperceived and unperceivable operation ( पत्नी(ऋयव्यापार) is put forward as a philosophical (epistemological and metaphysical) proposition to justify the Nyaya analyisis of the causal nexus into mere invariable and unconditional antecedence among phenomena without productive power efficiency पनवाविद्यास्य निवनपुर्वविदेश-Bháshá-Parichchheda). It is not of course intended to question the existence of Parispanda, which is of the nature of motion, and which, though subtile and therefore infra-sensible ( मूच and बहुद्द्रस्थ, not पतीन्द्रव ), is the ultimate form of all physical

activity. (परिसन्द एवं भौतिकी आपार: करीकर्ष:। चतीन्दिश्म आपार: नासीति दूमहे।.....तकात् कारकचलेच चलता जन्मते फलन्। न पुनदलनादन्यी आपारचपलभते। Jayanta, Nyáya-Mañjarí, Ahnika I).
The effect (no less than the action) is, in all cases of material causation, the resultant of the combined motions of the various (material and efficient) causes involved (e.g. in the case of पाक-समृदितदेश्दणादिसक्वकारकनिकरपरिसन्द एवं विशिष्टकलाविक्तः पाक 
क्लुच्यते। ... वयं कापार एवेष: सर्थः समृद्ध साध्यते।
किं फलनापराखंवः तदि संस्य साध्यताम्।—Jayanta, Nyáyamañjarí, A'hnika I).

But, in the Nyaya-Vaiseshika, though all action of matter on matter is thus resolved into motion, conscious activity is sharply distinguished from all forms of motion. as against the Sankhya-Vedanta, which, as we have seen, considered every thing other than Intelligence, the Purusha or the transcendental Self, to arise in the course of cosmic Evolution, and therefore to be subject to Parispandic motion. (कियाबियेष प्राथं व्यापारी प्रावृत्यक्षः :—Quoted in Jayanta's Nyaya-mañjari, A'hnika IV).

Santána, i. e. Gati-santána (including wave motion and current motion or convection): Kampa santána, Spandana, (vibration):—Charaka notes three kinds of santanas, serial motions, riz., those of water, sound and light (.जलसनान, मञ्चलनान and परिस्तान ). Chakrapani points out that a wave of sound travels more rapidly than a wave of water, and much less rapidly than a ray of light. In Hindu Mechanics, a current of water (downward flow, सन्दन) is conceived to consist of particles moving in an uninterrupted series under the action of gravity and fluidity ( जुदल and इवच ). A ray of light implies the rectilinear propagation of indefinitely minute corpuscles, in all directions, with inconceivable velocity, and a sort of conical dispersion ( चित्रको डि वेगातिमधः तेज:प्रसर्पत काम्रोति पृथ्ययुलात Uddyotakara-Vachaspati ). A wave of water ( affe-तरक) implies the transmission of vibratory motion in the water particles. (Cf. Jayanta-पत्रचनपयोविन्द-संदायस्यन्दनकमात, A'hnika II). A wave of sound is conceived by some on the analogy of a wave of water ( बीचितरक्रवाच ), only the air-waves ( cf. the Mimamsa ) or the sound-waves in and through the vehicle of air waves (cf. the Nyaya-Vaiseshika ) travel by concentric circles not in one but in all planes. (N. B. this assumes transverse waves ). Others hold that the air waves (cf. the Vakyapadiya) or the sound and air waves (cf. Uddyotakara ) are propagated by the transmission of the vibration in all directions, leading to conjunction and disjunction of air-particles, so that the wave may be said to expand by alternate concentric

spherical layers of rarefaction and codensation (awa ) (N. B. this assumes longitudinal waves),-(कदम्बरीलकमाय-cf. संधीयविभागा नेदनवर्षेण क्रियसाकाः श्रदमभिव्यक्षनी नादश्रद्शाचा: (Savara-Bháshya 1-1-17) श्विमितानि वायुन्तराचि प्रति में :बा व।यव: धावमाना: सर्वतीदिकान सं यागिवभागान् चत्पाद्यन्ति :-ibid. 1-1-I3). The Vákya-padíya describes articulate sounds (Varnas) and indeed all sounds ( sabdas ) as only forms of air set in motion, with rarefaction and condensation ( प्रवह ), and capable of variations of velocity and configuration (सानेपाभइती बायु: बन्दलं प्रतिपदाते। तस्य कारणसामधीत वैगप्रचयधीर्थायः। संनिपातात सारकलीऽपि मुर्भय:- Vákya-padíva, विभव्यने Kanda I. Sloka 109 ) (vide my paper on Hindu Mechanics and Physics ). (For the Hindu doctrine of scientific Method, vide Appendix; for certain interesting recipes of chemical technology, vide Addenda ).

I had intended to conclude this survey of Hindu Physico-chemical science with a comparative estimate of the evolution of scientific ideas in the culture-history (kultur-geschichte) of the Chinese, the Greeks and the Arabs, as an Essay in the historico-comparative method of investigation (vide the Introduction to my Comparative studies in Vaishnavism and Christianity for a correction of this method), but space forbids, and the reader too, I fancy.

## The Date of Rasaratnasamuchchaya.

While the present volume was about to issue from the press, Mr. T. G. Kála, Editor of the Marhattá Journal "Samálochaka", sent us a critical notice of R. R. S. As there are some important historical facts brought to light and as the date of this work arrived at from quite independent sources tallies with that assigned by us (Vol. 1. Intro. LXXXIX), we make no apology for reproducing its substance in a condensed form.

Charpati or Charpatinatha of the Natha school is mentioned in the R. R. S., (see VI, 58, Poona edition), as also king Singhana.

The Navanátha Saktisára, a Marhattá work by Narahari Mála, gives some legendary information about this Charpatinátha and speaks of him as a contemporary of Matsyendranátha. On the left has

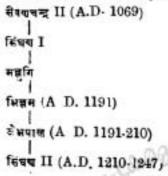
मत्केन्द्रनाय | गोरचनाय | गेनीनाय | निहत्तिनाय | गानदेव

been given the geneology of the pupils of मन्सेन्द्रनाय. The last, प्रामदेव or प्राप्तेयर, was the celebrated Marhattá Saint and author of a commentary on the भगवद्गीना called प्राप्तियो. It was written in Saka 1212,

i.e., A. D. 1290. So দৰ্শীৰ and Charpatinatha must have lived at the beginning of the thirteenth century A. D.

<sup>\*</sup>See the concluding portion of সাইস্থী, a Marhatta work.

The R. R. S. which mentions the Siddha Charpati must be therefore later than the first half of the thirteenth century A. D.



Among the Yadava kings of Devagiri or Daulatabad, there were two kings by the name of Singhana. Taking the Singhana mentioned by R. R. S. to be the second, we are required to place the composition of the

work in the latter half of the 13th century. On the whole the R. R. S. may be safely taken to be a work written about 1300 A. D.

## THE WEIGHT OF AIR.

( By Principal B. N. Seal ).

Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, e.g., metallurgy, dyeing, pharmacy, perfumery, cosmetics, horticulture, and themaking of glass (lenses and mirrors of various kinds are mentioned, the spherical, oval—sw and arise, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). But of Experiment as an independent method of proof or discovery, the instances are rare. I may

note one interesting example in Udayana's Kiranavali, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhûta. for if air were made of the Earth-Bhuta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says by one who accepts the weight of air-that this argument is inconclusive. For a counterexperiment may be suggested. The balloon filled with smoke ( or gas, wa) rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (gas, sa) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. at : least as applied to gases. Vallabháchárya in the Lilavati speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float or to come up to the surface of the water but the description shows that he had no clear ideas on the subject. Cf. Udayana, Kiranávalí, बाव्यविष्युषम । Cf. also Vallabhácháryva, Lílávátí.

## APPENDIX.

On the Scientific Method of the Hindus.

(By PRINCIPAL BRAJENDRANATH SEAL.)

The Doctrine of Scientific Method :- A study of the Hindu Methodology of Science is absolutely essential right understanding of Hindu to positive Science, its strength and its weakness, its range and its limitations. Apart from this rigorous Scientific Method, Hindu Chemistry, such as it is, would be all practical recipe, or all unverified speculation. This, however, would be a very inadequate and indeed erroneous view of this early achievement of the human mind. That the whole movement was genuinely and positively scientific. though arrested at an early stage, will appear from the following brief synopsis of the Hindu Methodology of Science.

Criterion or Test of Truth (after the Buddhists): The ultimate Criterion of Truth is found not in mere cognitive presentation, but in the correspondence between the cognitive and the practical activity of the self, which together are supposed to form the circuit of conscionsness. That knowledge is valid which prompts an activity ending in fruition. Cf. the distinction between unitaria and function of the distinction between unitarian and function.

Vátsyáyana). Truth, the Buddhists contend, is not self-evidence, not the agreement between ideas, nor the agreement of the idea with the reality beyond if any, for this cannot be attained direct, but the harmony of experience ( सन्दाद ), which is implied when the volitional reaction, that is prompted by a cognition and that completes the circuit of consciousness, meets with fruition, i. c., realises its immediate end tef. Sríbarsha, Khandana Khanda Khádya on the relation of पमा to शीकव्यवदार ). This is the material aspect of Truth. The formal aspect is given in a principle which governs all presentations in consciousness, and which combines the three moments of Identity, non-Contradiction and Excluded Middle in every individual cognitive operation (बदुक वन परिष्यमध्य (identity) चन्द व्यविक्रमित (non-contradiction) हतीय-प्रकाराभावं च मूचयति (excluded middle) प्रति एकप्रमाण-व्यापार:-Jayanta, Nyaya-Manjari, श्रमाणक विश्वसम्बन्धन ]

Perception:—The conditions of perception, and its range and limits, were carefully studied. The minima sensible (e.g., the minimum visible, the Trasarenu, the just perceptible mote in the slanting sunbeam), the infra-sensible ( प्राच्य स्थ. sometimes termed प्रतीह्य the obscured ( प्राच्य स्थ. a meteor in the mid-day blaze), and the potential ( प्राच्याचि ), are distinguished; but finer instruments of measurement were wanting, and this was a principal cause of arrested progress. It may be noted that the measurement of the relative pitch of

musical tones was remarkably accurate and original (vide my Paper on Hindu Mechanics and Physics).

Observation (दर्भन-Vachaspati and Udayana) :-The entire apparatus of scientific method proceeded on the basis of observed instances carefully analysed and sifted. This was the source of the physico-chemical theories and classifications, but in Anatomy, the Hindus went one step further; they practised dissection on dead bodies for purposes of demoustra-Ingenious directions are given, e.g., the body must be first disembowelled and wrapped round with the kusa and other grasses, than kept immersed in still water for seven days, after which the medical student should proceed to remove the layers of the skin with a carefully prepared brush made of the fresh elastic fibres of green bamboos; -which will enable the tissues, vessels and ducts to be observed. Post-mortem operations as well major operations in obstetric surgery (the extraction of the fœtus, etc.) were availed for embryological observations (e.g., it is stated a result of observation that the rudiments of the head and the limbs begin to appear in the fœtus in the third month, and are developed in the fourth : the bones, ligaments, nails, hair, etc. becoming distinct in the sixth) ;-and also embryological theories. e.g., the indication of sexual character in the second month by the shape of the fœtus, the shape of a round joint indicating the male sex, and an

elongated shape as of a muscle the female sex (cf. Charaka, Sûtraethána, Chap. IV, -- হিনীই দাধি খন: सम्बद्धते पिरा पेकार्थंदं वा। तब धनः पिराः पुरुषः स्त्री पेथी पर्व्यदं नपंसकमः Chakrapáni notes : धन: कठिन:। पिछो पन्याकार:। पेशी दोधनांसपेकाकार:। धर्मार वर्शलीवतम loc. cit.) Phonetics (as in the Prátisákhyas, circa 600 B. C.), Descriptive and Analytical Grammar (as in Panini), and in some important respects in Comparative Grammar (as in Chanda's and Hemachandra's Grammars of the Prakrita Dialects, the observation was precise, minute and thoroughly scientific. This was also the case in Materia Medica, and in Therapeuties, especially the symptomology of diseases. In Meteorology, the Hindus used the rain-guage in their weather forecasts for the year. made careful observations of the different kinds of clouds and other atmospheric phenomena (e. g., they give the Leights of the clouds, the distance from which lightning is ordinarily visible, or the thunder is heard, the area of disturbance of different earth-quakes, the height to which the terrestrial atmosphere extends, etc., vide Varáhamihira, Srípati, and the authorities quoted by Utpala). In Astronomy, the observation was, generally speaking, very defective as in the determination of the solar and the planetary elements, and this was probably due to the lack of practical interest, but the determination of the lunar constants entering into the calculation of lunar periods and eclipses, matters in

which the Hindus had a practical ceremonial interest, reached a remarkable degree of approximation (much above Greco-Arab computations) to the figures in Laplace's Tables, which can only be explained by the circumstance that in the case of these constants the Hindus carried out for more than a thousand years a systematic process of verification and correction by. comparison of the computed with the observed results (like the navigator's correction of the course of the ship at sea), a process which was termed हन्तिका. In Zoology, the enumeration of the species of Vermes, Insecta, Reptilia, Batrachia, Aves, etc., makes a fair beginning, but the classification proceeds on external characters and habits of life, and not on an anatomical basis. In Botany, the observation was mainly in the interests of Materia Medica, and the classification was as superficial as possible. (Vide my paper on the Hindu Classification of Plants and Animals).

Experiments:—Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, e. g., Metallurgy, Pharmacy, Dyeing, Perfumery and Cosmetics, Horticulture, the making and polishing of glass (lenses and mirrors of various kinds are mentioned, the spherical and oval swand with, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). And the

results of such experiments were freely drawn upon for building up scientific hypotheses and generalisations. But of experiment as an independent method of proof or discovery, the instances recorded in books are rare. I may note one interesting example in Udayana's Kiranávali, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhuta, for if air were a form of the Earth-Bhuta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane. filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says, by one who accepts the weight of air-that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, va), rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (or gas, पम ) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. Vallabhácháryya in the Lilavati, it is true, speaks of a peculiar resistance to sinking (or gravity ) exercised by water, which explains the tendency in certain objects to float

or to come up to the surface of the water, but the description shows that he had no clear ideas on the subject.

Mathuránátha, again, states that the determination of the degree of purity ( the carat ) of gold by rubbing against the assaying stone and observing the character of the yellowish streak against the black smooth background, is only an indirect means of ascertaining weight (गुरुवदेशचया lit, specific gravity) -which seems to suggest that there was a more direct means of arriving at the latter. Probably this refers to the common Indian method of comparing the lengths and weights of wires of uniform thickness that can be formed by drawing different pieces of gold through the same diamond bore. I think it may be regarded as fairly certain that the Hindus were ignorant of Archimedes's discovery, an ignorance which, at any rate, they could not have well borrowed from the Greeks, no more than they could have thus borrowed their knowledge of unknown to the Greeks themselves. [ Cf. Udavana, Kiranávali :-

वायुनिक्ययम्, कि च (वायी:) पृथिवीले गुरुलम्पि स्नातः न च पवनापूरितस्य चर्मपुटकादैः चपूरचदमातः चिक्षं चवनसनन्। छत्नीय-सानस्य धूमापूरितेन इदम् चनैकालिकं इति चेत्। न । चसं धूमदमायाः । कवापि वरिम्नियम्बद्धतोरवनिर्विभिष्य चप्रतितः।—ef. Vallabhácháryya, Lílávatí—गुरुलविभेदेऽपि पावाचाचावृतस्तिषु स्व्यनी-चळ्यन नियमवत् चट्टच्डेनुकता सान्धेऽपि पतनीत्पतन-नियमी भविष्यतीति । चैत् न। जलाधीनमः जलीन धार्च पतनप्रतिबश्च सम्माजनं एतम् जलस्य योगस्य कस्यचिदेव पतनप्रतिवश्वसामधीगत्। दृष्ट हेतुकसेव मञ्जनस्य सम्माजनस्य)—of. Mathuranátha, सन्निकर्धवादरहस्य on Gangera's Tattvachintamani—तस्य (निक्यीयलस्य) न सुवर्ध-पौताभिन्यस्रकालं किन्तु पौतदारा गृहस्यवेलस्यस्यस्य कलसेव तस्य।

Fallacies of Observation—Mal-observation and Non-observation:—These were carefully studied in relation to errors of observation, and Hallucination (अस प्रशास, पारीप)—which were ascribed to three causes:—(a) Dosha, दीप, defect of sense organ, as of the eye in jaundice, or of the skin in certain forms of leprosy (leading to tactile insensibility, cf. Susruta) or defect of necessary stimulus, e.g., too faint light, or undue distance or nearness, in vision; (b) Samprayoga, सम्भाग, presentation of a part or an aspect instead of the whole; and (c) Sanskára, संस्थार, the disturbing influence of mental predisposition, e.g., expectation, memory, habit, prejudice, etc.

The Doctrine of Inference:—Anumana (Inference) is the process of ascertaining, not by perception or direct observation, but through the instrumentality or medium of a mark, that a thing possesses a certain character. Inference is therefore based on the establishment of an invariable concomitance (Vyápti, आणि) between the mark, and the character inferred. The Hindu Inference (Anumana) is therefore neither merely formal nor merely material, but a combined Formal-Material

Deductive Inductive Process. It is neither the Aristotelian Syllogism (Formal-Deductive Process). nor Mill's Induction (Material-Inductive Process), but the real inference which must combine formal validity with material truth, inductive generalisation with deductive particularisation.

An inference admits of a rigorous formal statement,-in the shape of five propositions, for dialectical purposes (i.e., in demonstrating to others ), or of three propositions when the inference is for one-self (सार्यानुनान):-(1) the probandum, the statement of the proposition to be established ( ঘৰিলা, ভাষ্মৰিল্ল, e.g., yonder mountain is fiery (say, an active volcano); (2) the reason, the ascription of the mark ( इतु, सिक्टब्यपदेश ).- e.g., for it smokes; (3) now, the general proposition, stating the invariable concomitance which is the ground of the inference,-clenched by an example bringing home the responsibility of the reasoner to establish a real relation, e.g., whatever smokes is fiery, as an oven; ( चदाचरप) ;-(4) next, the application, the ascertainment of the existence of the mark in the present case ( चपन्य ) e.g., yonder mountain smokes ;- (5) finally, the conclusion, the probandum proved (भितमन), e.g., yonder mountain is fiery.

- Yonder mountain is fiery.
- 2. For it smokes.
- 3. Whatever smokes is fiery, as an oven.

- 4. Yonder mountain does smoke.
- Therefore, yonder mountain is fiery.
   For inference for oneself, only the first three or the last three propositions, are held to be sufficient.

The Hindu Anumana, it will be seen, anticipates J. S. Mill's analysis of the syllogism as a material inference, but is more comprehensive; -for the Hindu Udaharana, the third or general proposition, with an example, combines and harmonises Mill's view of the major premise as a brief memorandum of like instances already observed, fortified by a recommendation to extend its application to unobserved cases, with the Aristotelian view of it as a universal proposition which is the formal ground of the inference. This Formal-Material Deductive-Inductive process thus turns on one thing-the establishment of the invariable concomitance ( जाति ) between the mark and the character inferred,-in other words, an inductive generalisation. The question is-what is warrant for taking the leap from the observed to unobserved cases? Under what conditions we justified to assert a Universal Real Proposition on the basis of our necessarily limited observation ?

The Charvaka view:—Among the Charvakas there were two classes, the cruder school of materialists who accepted perception ( ) as a valid source of knowledge, as well as the reality of

Natural Law (स्थाप), and the finer school of sceptics. who impugned all kinds of knowledge, immediate as well as mediate, and all evidence, Preception as well as Inference, vide Jayanta's reference in the Nyaya-Manjari to सुनिवित्रणानाता: also पान्नाकप्रमेस इति प्रतिज्ञाय प्रमानप्रमेधसंस्थालच्या-च्यातकाचं व्याच्यास्याम नियमाञ्चलकरवीवलमेन व्यास्त्रातवान-A'hnika I, Manjarf.

The Charvakas hold that the principle of causality, which the Buddhists assume to be a ground of an induction ( आपि ) is itself an induction ( a case of Vyapti ), which amount to reasoning in a circle ( TET); that every inference is based on an unconditional invariable concomitance which itself must be inferred, as universal propositions cannot be established by our limited preceptions. and thus there is a regressus ad infinitum ( wants greggi); and that the nexus between cause and effect, or between the sign and the thing signified (e.g., smoke and fire) is only a mental step or subjective association based on former perception, a mental step which by accident is found justified by the result in a number of cases.

The Buddhists - their Analysis and Vindication of Inference : - The Buddhists, however, take their stand on the principle of the Uniformity of Nature ( प्रतिवस, स्तभाव प्रतिवस, Nyaya-Vindu). This uniformity, for scientific purposes, has to be divided into two different relations,-(1) the uniformity of succession in the relation of cause and effect, e.g.,

of smoke to fire (कार्यकारकमात्र, तदुन्पचि, Nyaya-Vindu); (2: the uniformity of co-existence ( in the form of co-inherence in the same substrate) in the relation of genus and species, e.g., the relation of invariable concomitance expressed in the proposition,-all Sinsapás are trees,-which is not a relation of causality, but of co-existence or co-inherence in the same substrate (i.e., the co-inherence of the generic qualities of a tree with the specific characters of a Sisu tree, in this particular individual before me, a Sisu tree),-a relation which may be termed essential identity ( तादाला, खनाव-Nyava-Vindu ). To these two, the Buddhists add a third ground of inference, non-perception of the perceptible (पनुपन्निम: इम्बानुपन्निम), which is employed in inferring the absence ( sfary ) of a thing from the non-per ception of something else. In all cases of inference based on the Uniformity of Nature, the relation is that of inseparableness or non-disjunction between the mark and the character inferred. The question is-how is this inseparableness ( इतिमाभाव ) ascertained, and what is the warrant of our belief in it, in these cases?

Ascertainment of Inseparableness or Non-disjunction: Buddhist Account: - First take the case of causation. The cause is the invariable antecedent of the effect. What is meant is that the specific effect (with all the distinctive and relevant accompaniments, कार्यक्रिय) is invariably preceded by a

specific cause (कारपविशेष ). It is not that clouds always lead to rain, or that floods in the river valley always imply rain in the hills higher up. But this particular conjunction of antecent circumstances (e.g. the appearance of a particular kind of clouds accompanied with flashes of lightning, the roll of thunder and flights of Valakasdriven by the wind from a particular quarter of the horizon, and ascending in black masses, etc.) is as a rule the precursor of a particular assemblage of rain effects ( rain with particular accompaniments). Again, this particular kind of flood (overflowing of the river banks accompanied with muddy discoloration of the water, rapid currents, the bearing down of tree trunks, etc.) is always preceded by rain in the hills higher up (though, no doubt, other case of floods in a river may be due to a breach in an embankment or the melting of the snows). In other words, the Buddhists (and the earlier Nyáya Schools ) avoid the difficulty arising from the plurality of causes by taking into consideration the accompanying phenomens, which, properly marked, would always point to a specific cause of a specific effect.

I quote Nyáya authorities, but this device to obviate the plurality of causes is common to the early Nyáya and the Buddhistic systems.

पूर्वदत्। यम कारचेन कार्धमनुमीयते। छदाइरचम्-

मेशीत्रया स्विष्यति अप्टिरिति कारणेन कार्यानुसानम्। कथं

पुनरस्य प्रयोग:। बल्सिन: पति मेघा: गधीरध्यनियस्वे सति बहुबसाकाः वस्ते सति पविरयभावस्ते सति स्वत्तमस्तात इष्टिमकोधनत ।

प्रेषवत् ( यत कार्येच धारचमनुभीयते )—छदाहरचम्—

खपरिड एसहे प्रस्कान्य निमीत: श्रीप्रते सति पूर्णपालकाष्ठादि-बडमबले सति प्रवेतात प्रवेतिष्टमसदीबदिति। (Uddyotakára, Chap I. A'hnika 1, Sútra 5). Váchaspati puts this clearly :- यदापि कारणमाने व्यभित्रशत कार्योत्पारं तथापि याहर्य न व्यक्तिपरित तप निपुर्वन प्रतियमा भवितव्यम् । चन्यवा ध्मनातमपि विज-सत्तां व्यक्तिवास अमित्रेषो गसको भवेत्। In other words, a single condition called a cause is not invariably succeeded by the effect, nor does the effect phenomenon in general point to any particular cause as antecedent, for there may be a plurality of causes of a general effect. The skilful observer will therefore select the full complement of causal conditions, which is invariably succeeded by the effect, - and also the specific effect (e.g., अ अविकेष) which points to a specific causal antecedent. Compare also Jayanta :- we infer an effect from a specific assemblage of causes—न प कारपमावस इंतर्क वृत्ती येनाम्य व्यक्तिचार: स्वात्। चपि च विश्रिष्टसेव कार्य हेतु:। न च कारणविश्रेवी दुरवगमः। गधीरनिर्व्वतारकानिर्भविशिरमधराः रीलम्ब-गवलव्यासतमासमितिमात्रायः...इष्टि व्यक्तिषरमी इ वेत प्रायः प्रशीमचः। चनन्युपगमे चैवमनुमानसा जीवितम्। न स्यात्मविशेषायामपि वीड्सufma: 1 Similarly we infer a specific cause from a specific assemblage of effects :- प्रवर्गदित यह कार्येष

कारचमनुसीयते यथा नदीपुरेण छपरितने देशे हांप्टरिति। हिएसत-प्रदेशसंख्या दय नदी फॅनिलकल्पकादिविधियपूरीपेतलात्। यश नितुभद्रकिमिवलयगादिमापि नदीपुरीपपत्तिह या इति तवापि 'लचाते-

बमा तुरपराधीऽशं विशेषं यी न पश्चति।

नानुमानस्य दोषोऽसि प्रमेयान्यभिचारियः ॥

( Nyáya-Manjarí, A'hnika 2, on Gotama Sútra 5, A hnika 1, Chap 1. )

A specific assemblage of causes, therefore, has only one specific assmblage of effects, and vice versa. Of course, the observer is to find out the essential or relevant features ( as distinguished from the irrelevant ones ) which, being included, will enable him to specify the particular cause of the particular effect.

Now this being premised to be the exact meaning of the inseparableness or non-disjunction in the case of cause and effect, we come to the question with which we started-how is this relation to be ascertained or established between two phenomena or assemblages of phenomena ? Obviously, mere observation of their agreement in presence ( ) and their agreement in absence ( व्यक्तिक ) is no help Take a concrete example. The in the matter. ass is customarily employed to bring the fuel with which fire is lighted. In a hundred cases you have observed the ass among the antecedents of smoke. In a hundred cases you may have observed that when there is no ass, there is no smoke. This is no

warrant for concluding a relation of cause and effect between an ass and smoke. It may be that you happen to have never observed smoke without an antecedent ass, or an ass without smoke following. Even this is of no avail. It is not agreement ( unbroken and uniform though it be ) in presence, or in absence, or in both, that can settle the matter. There is one and only one way of ascertaining the causal relation, Suppose A with certain accompaniments is found to precede B immediately. Now if A disappearing, B disappears, even though all other antecedents remain and there is no other change in the case, then and then only can the causal relation be ascertained. It is not a mere table of positive instances or negative instances ( चदर्मनाव न दर्मनात ) :- it is this method which we may term the Method of Subtraction ( the Method of Difference in its negative aspect ) that is the only exact and rigorous scientific Method. Such was the statement of the earlier Buddhists (cf. Uddyotakára's and Váchaspati's report of the Buddhist Doctrine of Inference—स हि प्रतिक्यो न दर्भनमायावसेय: ।

तकात् तादाकाातदुत्पचिनियमः एव प्रतिबन्धः । यदाइ कार्यकारयः भावादा सभावादा नियमकात् । भिवनाभावनियमीऽदर्शनात न दर्शनात् —a Buddhist Káriká quoted in Váchaspati, Udayans; Sríharsha, Mádhava, etc.)—कार्यकारयभावय ददम्—भिकन् सति भवति—सन्सु भिव तदन्येषु भिक्षत्रसति न भवति—एवमाकारः । न भन्यव्यतिरैकाम्यासतिरियते ।...(एवं तादाकामपि विषयंदै दाधक प्रमाणीयपच्या नियेतच्या ....तथात तादात्रातदत्यक्तिभ्यामेव प्रतिबन्धी नान्तः ।-- Vachaspati, Tátparyyatíká, Chap I, A'hnika 1, Sutra 5, अनुमानलक्षणम्-व्यक्तिरशीपाय: )

But the canon in this form is not sufficiently safe-guarded against possible abuse. Two points have to be emphasised :- (1) It must be carefully observed that no other condition is changed, (2) that the appearance and disappearance of A must immediately precede the appearance and disappearance of B. The definition of a cause is based on two fundamental characters, (1) the unconditional invariableness of the antecedence, and (2) the immediateness of the antecedence. The canon of the Method of Difference must therefore be stated in such a form as to emphasise each of these aspects. And one main difficulty in the practical application of the canon is that along with the introduction or sublation of an antecedent, some other phenomenon may be introduced or sublated unobserved. As a safe-guard against this radical vitiation of the Method, the later Buddhists formulated the canon of a modified Method, termed the Panchakárani, a Joint Method of Difference, which combines the positive and the negative Methods of Difference (the Method of Addition and the Method of Subtraction ) in a series of five steps, and which equally emphasises the unconditionality and the immediateness of the antecedence as essential moments of the causal relation. This is

neither agreement in presence, nor agreement in presence as well as absence (the foundation of J. S. Mill's Joint Method of Agreement), but the Joint Method of Difference. The Panchakárani runs thus:—

The following changes being observed, everything else remaining constant, the relation of cause and effect is rigorously established:—

First step.—The 'cause' and the 'effect' phenomena are both unperceived.

Second step-Then the 'cause' phenomenon is perceived.

Third step-Then in immediate succession, the 'effect' phenomenon is perceived.

Fourth step-Then the 'cause' phenomenon is sublated or disappears.

Fifth step-Then in immediate succession, the 'effect' phenomenon disappears.

Throughout, of course, it is assumed that the other circumstances remain the same (at least the relevant or material circumstances).

This Panchakarani, the Joint Method of Difference, has some advantages over J. S. Mill's Method of Difference, or what is identical therewith, the earlier Buddhist Method; and the form of the canon bringing out in prominent relief the unconditionality and the immediateness of the antecedence, is as superior from a theoretical point of view to J. S. Mills's canon,

and is as much more consonant than the latter to the practice of every experimenter, as the Hindu analysis of Anumana as a Formal-Material Deductive-Inductive Inference is more comprehensive and more scientific than Aristotle's or Mill's analysis of the Syllogism (or Mediate Inference').

But even the Panchakárani is no sufficient answer to the question with which we started. The Panchakárani is only a method; it shows only how in a particular case the relation of cause effect is to be established ( प्रतिवश्ववदीपाय ). But we want more than this-we require a warrant for the process. The Buddhists therefore supply the following proof of the Method :- Doubt is legitimate, but there is a limit to doubt. When doubt lands you in an unsettlement of a fundamental ground of practice, and would thus annul all practical exercise of the will, the doubt must cease ; else the doubt would be suicidal or sophistical. In this particular case, when the Panchakarani is satisfied, the antecedent in question must be the cause, for there is no other antecedent to serve as cause; the proof is indirect but rigid. If this be not the cause, there is no cause of the phenomenon. It was not, and it begins to be, without a cause; which would be a contradiction of the rational ground of all practice, for all volitional activity proceeds by implication on the principle of causality. If things could happen

without a cause, all our motives to action would be baffled. The link between a presentation and the instinctive volitional reaction would snap, and the circuit of consciousness would be left complete. In fact, the Buddhists go further; they hold causal efficiency ( wifage; ) to be of the essence of empirical (relative) Reality. The proof of the Joint Method of Difference, then, lies in a strict application of the principle of causality in its negative form ( viz., there can be no phenomenon without a cause) and the truth of this last is guaranteed by the same ultimate criterion of empirical ( relative ) Reality as the truth of Perception itself, viz., the correspondence between the rational and the practical activity of the self.

But invariable concomitance (or non-disjunction), the Buddhists argue, has another form, e. g., the relation of the genus to the species. We may have perceived a hundred instances of the association of certain characters with certain others; we may also have never perceived the former when the latter are absent; but this would not enable us to generalise and establish invariable and unconditional co-existence. We must be first satisfied that there is identity of essence ( अवस्था समात्र ). It is only when we perceive that the characters of a Sinsapá are co-inherent with the generic characters of a tree in the same individual object (a Sinsapá tree before me), and when we further

perceive that the characters are held together by the relation of identity of essence, that we can say that all Sinsapas are trees. For as there is identity of essence, a Sinsapa would not be a Sinsapa. if it were not a tree. It would lose its self-identity which is a contradiction. Hence the relation of identity of essence ( तादाका सभाव ), as in the relation of the species to the genus, is the sole ground for establishing uniformity of co-existence ( प्रतिबन्ध, समावप्रतिबन्ध ).

(For the Buddhist Method of Induction, in its later form, the Panchakárani, vide Sarvadarsana Sangraha - Buddhist reply to the Charvaka attack on Inference :-

यदम्यधायि चिनामानी दुर्वीच दति तदसाधीय:। सादालातदत्-पतिभ्यामविनाभावस्य सुन्नानलात् । तदुर्ता—कार्यकारयभावात् वा स्वभावात् वा नियासकात्। चिवनाभावनियमीऽदर्शनात्र न दर्धनात्। As for the Nyáya view चन्यव्यविरेकी पविनामावनियावकी इति ı-the Buddhist objects-नतु पर्व साध्यसाधनवीरव्यभिचारी दुरवधारणः भवेत् । भूते, भविद्यति, वर्त्तमाने चनुपलम्बमाने च स्विभार-श्रदाया पनिवारणात्।-the Nyáya retorts नत् तवाविषस्य छ तावकेऽपि मते व्यभिचारमदा द्रषरिष्टरा प्रति।-the Buddhist answers-मेर्च बीच:, विनापि कार्य कार्यमृत्पदाताम् इत्येवं-विधाया: प्रदाया: न्याधातावधिकतथा निश्ताताव। तदेव दि चामकोत यांकामामामाने व्याधातादयः नावतरेषुः। तद्वतं व्याचाता-विधराश्रद्धा दति। तकात् तदुत्पत्तिनिधयेन चविनाभावी निश्चीयते। तद्त्पत्तिग्यदय कार्यप्रेलो: प्रयचीपसमानुपसम्पद्यकनिवस्तः।

कार्यं उत्पत्तेः प्रागतुपलयः, कारणीपलये सति उपलयः, उपलयसः प्यात् कारणातुपलयात् चतुपलयः इति पचकारण्या घृम-घृमण्यव्यीः कार्यकारपश्चायः निश्चीयते । तथा तादाक्षात्वियते चित्र चित्रभावः निश्चीयते । यदि शिश्चपा इचलम् चित्रपतित् साक्षानसेन कण्यात् इति विपत्ते वाधकण्यते । चप्रकृते तु वाधके सूदः सङ्भावीपलयोऽपि व्यक्षिणारश्चायाः को निवारियता । शिश्चपाद्ययशेष तादाक्षानिययः वर्षीऽयं शिश्चपा इति सामागिषकरस्ववलात् उपयद्ते । तथात् कार्यान्व्याने कारणम् चाक्षानम् चतुमाययत् इति स्वित् । Sarvadarsana Sangraha, Bauddha-Darsanam Vide also Sridhara Kandali.

The Nyaya Doctrine of Inference :- The Nyaya easily demolishes the Buddhist contention about identity of essence. The Nyaya writers, being realists, do not impugn the reality of the genus ( कार्व ) like the nominalists or the nominalistic conceptualists; but they point out that the inseparableness (or non-disjunction) in such cases can only be established by the experience of unbroken uniformity ( प्रश्निवारित i.e., by प्रवयवातिरिती, दर्भनाद्रप्रेने ). Uniform agreement in presence with uniform agreement in absence,-not the mysterious identity of essence irresistibly perceived in any individual case or cases-is the only basis for constituting genera and species in Natural Classification. Indeed some of the later Nyaya writers point out that individuals do not always possess in Nature all the characters that go to form the definition of the class to which they are referred.

Similarly, as regards the relation of cause and offect, a nexus is sometimes fancied to be perceived, a power in the cause to produce the effect ( nfm ). or an ultimate form ( नाति भीषा ), which is supposed to be present, whenever the effect (quality or substance) is produced (cf. Bacon's view of the 'Forms' of Simple Qualities). All this is neither a matter of observation nor of legitimate hypothesis. There is nothing except the invariable time-relation (antecedence and sequence) between the cause and the effect. But the mere invariableness of an antecedent does not suffice to constitute it the cause of what succeeds; it must be an unconditional antecedent as well ( चनवाचित्रक्ष नियतपुर्व-विश्वता, being the definition of कार्यकारयभाव ). For example, the essential or adventitious accompaniments of an invariable antecedent, may also be invariable antecedents, but they are not unconditional but only collateral and indirect, in other words their antecedence is conditional on something else (न स्ततना प). The potter's stick is an unconditional invariable antecedent of the jar, but the colour of a stick, or its texture or size or any other accompaniment or accident, which does not contribute to the work done (so far as we are considering it) is not an unconditional antecedent. and must not therefore be regarded as a cause. Similarly, the co-effects of the invariable antecedents, or what enters into the production of these

co-effects, may themselves be invariable antecedents but they are not unconditional, being themselves conditioned by those of the antecedents of which they are effects. For example, the sound produced by the stick, or by the potter's wheel, invariably precedes the jar, but it is a co-effect,and A'kasa (ether) as the substrate, and Vayu (air) as the vehicle, of the sound, enter into the production of this co effect, but these are not 'unconditional' antecedents, and must therefore be rejected in an enumeration of conditions or causes of the jar. Again, the conditions of the conditions, the invariable antecedents of the invariable antecedents. are not unconditional. The potter's father is an invariable antecedent of the potter who is an invariable antecedent of the jar, but the potter's father does not stand in a causal relation to the potter's handiwork. In fact, the antecedence must not only be unconditionally invariable, but must also be immediate (पन्यवहितपुर्व्यकालावक्टेरेन कार्यारेश स्थान). Finally, all seemingly invariable antecedents which may be dispensed with or left out, are ipso facto not unconditional, and cannot therefore be regarded as causal conditions; in short, nothing that is unnecessary is unconditional; for this class, vide Visvanátha नियतावस्त्रकपूर्वभावितः भवस्त्रकप्रतियतपूर्व्यवित्तंत्र एव कार्यस्थाते । तिहत्त्व (पतिरिक्तं ) पन्यवानिष्ठ-Visvanátha, Siddhánta Muktávali, on Sloka 20. For example, it is the custom to point to spatial position or direction with the

fingers, but finger-pointing, though invariably present, is not causally related to the perception of direction or spatial position, because we can imagine such perception without finger-pointing, ( घनवासिद्वतया चक्तवा निर्देशस दिक्रस्यक्तेन न खाभाविक: सम्मनः, Váchaspati, Tátparyya-Tiká, Chap, I, A'hnika I, Sutra 5,-this shows that the doctrine of waufeleva was long anterior to Gangesa).

Visvanátha in the Bhasha-Parichchheda mentions kinds five of. चनाणामित. conditional antecedents—(1) येन सहपूर्वभागः (2) यस्य ना मादाय ( पूर्वभाव: ), (3) चन्धंप्रति पूर्वभावे जाते यतुप्वभावविज्ञानम्, (4) कमकं प्रति प्रसंवर्षिताम् चपरिचाय यस ( प्रकंवर्षिता ) न रहाते, and (5) चवाचि यत् नियतावश्यकपूर्णभावितः चतिरिक्रम् भवेत् ( एतेष पश्च पावस्थकसासी-Slokas 19 and 20), यस स्नातस्थाप चनवन्यतिरेकी न सः किन् सकारयमादायेव चनवन्यतिरेकी राखेते तदन्यपाण्डिन, Siddhanta Muktavali, loc. cit.- The Dinakari points out that the first two cases are comprehended under the formula रतराज्यव्यविरेक प्रयुकान्वयव्यक्तिरेकशां जिल्ला There are several classifications of these irrelevant antecedents ( पन्यवाचित्र ) : I quote one of the best known].

The unconditional ( अन्यवासिदियुष ) as interpreted in this comprehensive sense is a far more fruitful conception than Mill's, and is well adapted to its work-the elimination of the irrelevant factors in the situation. In the end, the discrimination of what is necessary to complete the sum of causes, from what

is dependent, collateral, secondary, superfluous, or inert. (i. e. of the relevant from the irrelevant factors) must depend on the test of expenditure of This test the Nyaya would accept only in the sense of an operation analysable into molar or molecular motion ( परिसन्द एव भौतिको न्यापार: करीलाई:-बतीन्द्रयम् व्यापारी नामि, Jayanta, Manjarí, A'hnika I) ; but would emphatically reject, if it is advanced in support of the notion of a mysterious causal power or efficiency ( ufm ). This is a peculiarity of the Nyáya-its insisting that the effect is only the sum or resultant of the operations of the different casual conditions-that these operations are kinetic, being of the nature of motion, in other words holding firmly to the view that causation is a case of expenditure of energy, in the kinetic form,but at the same time absolutely repudiating the Sánkhya conception of power or productive efficiency as metaphysical or transcendental ( पतीन्दिय ). and finding nothing in the cause other than an unconditional invariable complement of operative conditions (कारकहान्यी ) and nothing in the effect other than the consequent phenomenon which results from the joint operations of the antecedent conditions (समुद्रितसक्तमकारकनिकर: परिचन्द एव-Jayanta-सामग्री काथे-सामग्रीकार्थले तु कार्यमञ्जू किमनरालवार्चना सक्ता-Jayanta, ibid, A'hnika, 1, मिन्राकरणम्—it may be noted that the Nyaya, while repudiating transcendental power (Sakti) in the mechanism of nature

and natural causation, does not deny the existence of metaphysical conditions like merit ( भर्म, ) which constitute a system of moral ends that fulfil themselves in and through the mechanical system and order of Nature - vide Jayanta. पत्रीन्द्रयं किमपि कारचे कल्पितमेव धर्मादि-A'hnika 1, प्रक्रिविशक्त्यम् ).

The causal relation, then, like the relation of genus to species, is a natural relation of concomitance ( जाप्ति: सामाविक: समन्य:-Váchaspati) which can be ascertained only by the uniform and uninterrupted experience of agreement in presence and agreement in absence, and not by deduction from a certain a priori principle like that of Causality or Identity of Essence.

Nyava objection to the Buddhist Method of Difference as a means of ascertaining causality.

Take for example the Buddhist deduction of Causality in any particular conjunction by means of the negative Method of Difference, or of the Panchakárani. The ascertainment of the causal relation by these Methods is open to the following objections :- (1) The unconditionality of the antecedent cannot possibly be ascertained. As the Charvaka rightly points out, the Methods enable you to eliminate irrelevant antecedents that are or can be perceived; but the introduction or sublation of latent or undetected antecedents can be imagined against which the Method of Difference is powerless. In the case of the production of

smoke, for example, by fire,—what if I say that an invisible demon intervenes in every case between the fire and the smoke, that this demon (fund) is the immediate antecedent and real cause of the latter, and that the fire is an accident which, in every such case, is brought about by its own causal antecedents;—in saying this, I do not go counter to the principle of causality and am landed in no contradiction (आपन) such as strikes at the very roots of all practice, or baffles the completed circuit of consciousness, however much I may violate probability.

In the second place, even supposing that the fire, in this particular case (which satisfies the Method of Difference rigidly) is ascertained to be the cause of the smoke, how can I know that fire is the cause in other cases, or that there is no other cause. You will perhaps argue that if there were an indefinite number of causes of the same specific phenomenal effect, it would violate the :principle that phenomena are all conditioned, i.e., exist only under certain conditions ( कादाचित्कल ), - which is more comprehensive than the principle of causality, and the contradiction of which equally overthrows all rational practical activity. Yes, 1 accept the conditionality of phenomena, but this is not violated by supposing that one specific assemblage of phenomena has more than one cause. It is true that if you suppose such plurality of causes, you cannot establish the invariableness of the particular conjunction ( green-wood fire and smoke ) which your Method of Difference fixes upon as a case of cause and effect; in other words, with your special principle of Causality so restricted. and without any general principle of Uniformity of Nature to fall back upon, you cannot ascertain, from the present case, or from any number of similar cases that you may have observed that all green-wood fires are followed by smoke; i.e., you are helpless in demonstrating with apodictic certainty (or ascertaining indubitably ) the relation of cause and effect. But this is an objection against your own position, not mine. Why not admit at once that certain phenomena are naturally connected (as invariable concomitants or antecedents) with other phenomena, and take your stand on observed concomitance (uniform and uninterrupted experience of agreement in presence as well as absence) without assuming causality as an a priori principle and making deductions therefrom, and without the trouble of ascertaining the relation of cause and effect in every individual case. I am free to admit that theoretical objections of irresistible force ( like those of the Chárváka Scepties ) can be urged against this ascertainment of universal invariable and unconditional concomitance (व्यक्तिवृद्धीपाय) on the basis of mere observation. Doubts of this kind can no more be laid by my view of the matter than by your canons of causality and essential

identity (तद्वपणि and तादाव्या). Ultimately we all have to fall back on the rational practice of thinking persons ( nwigm: ), and such persons are always content to act on practical certitude instead hankering after an unattainable apodictic certainty in the affairs of life ( प्रामाधिकखीकयावामन-पालयता यथादर्भनं महनीयम् ). This same practical certitude is also the ultimate warrant of the Deductive-Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark,

[ To the earlier Buddhist canon of the Method of Subtraction, f. e., the negative Method of Difference, Uddyotakara and Váchaspati of the Nyáya School pertinently and acutely object as follows :-

सर्व यत किचित् कचित् इष्टं तस्य यस प्रतिनमः, तरिदः तस्य तत् बसके तब इति चनुकाशीम:। स एवं तु प्रतिबन्धी न ताबत् तदत्वप्रशा समावति । का प्रमरियं तदुत्पत्तिः । धुमसा किंदजानकरं भावः । स ताहम: पश्चि राग्रभसापि। तत्प्रतिवडीऽपि भ म: स्रात्। पर्यं तदनकः रमेव भारः, न च रासभाननारं भवद्रपि तदननारमेव भवति. तक्किन् सति व्यपि व्यक्ति वाही तदभावात्। वासति व्यपि तक्षित् सत्याईश्वनवति बक्री तदमावात्। चय यदापि धुमस्य बह्मिावानुविधानं तबीपल्यः, तथापि देशान्तरादिषु तद्भावीऽस्थ क्रतस्यः। तथा हि भूयी सूची रासभी दृष्टे घूमी दृष्टः, तदभावे च घटष्ठः, न स तत्कार्यः । तक्कातीय-स्त्रेव घुमस्य रासमं विना सति वड्डी भावात्, एवं सत्यपि चग्नी पिशाचेन जनिती भूमः, कचिद्देशादी तत्जातीय एव रासभवदवसुमाविऽपि पिशाचा-देव भविष्यति, इति चवन्त्रं प्रद्या भाव्यं निवासक्तम चपश्रताम्। न च स्रति

भावमार्वं नियासकं, तस्य रासभादिषु चित्रशिषात्। तदननारमेव इति च चवधारपस्य महायामभावात्। चवधारयेन तु महापनयने परस्परायय-प्रसङ्गात

Buddhist reply :- सादेतत्। यो यो धुनो हट: स सर्वसावत् षाद्रेश्वनसहितवत्रानलरमेव, न विभावानलरं। स व कादावित्कतया निभिक्तमधैचमायी यदनन्तरमेव गमते तदेव बहतीतव्यभिचारं निमिन्तं करीति, न तु प्रतीतव्यभिचारं रासभादि। नापि सर्व्यवादनुपस्थापिका चादिः। यदि न ततिमित्तं कथात् विनाऽपि वर्षिः कचित् धूभी न छप-लभाते। वय वसी (पिशाच:) सर्वया विष्कृतिः तथा सति वादेश्वन-वत् कर्यविद्वरिय न कारचस्। कारचे चेत् कर्यतम्भरिय भूमभावशद्या। Now the phenomenon that is contingent ( कादाविलक ) cannot be uncaused—पकारपास हिं सामा सा किया सामा अक्षां वा कान्, अभ्येचलात न आदाधितकस्त्र । And with the limitation of a specific effect, there must be only one specific cause, for an unrestricted plurality of causes would amount to the denial of uniformity in causality ( i. e., of the unconditional invariable antecedence )-

नापि चनेकं कार्यं, चकारचलप्रसङ्घदिव । वज्रामनारमेव भाव इति हि ध्मस्य बक्रिकार्थलम् । स चेत् चवर्षेरिय चनकरं, न एवकारार्थः स्राप्त, इति न वहुं: कार्थ्यम् । एवम् चन्यसापि न कार्थ्ये । न डि चन्याननारसिव भवति, वष्टुरेपि चनारं भागत्, तत्व चर्चतुको धूमः स्नात्। तथा च कादाचित्रकलमाइति:।

Nyáya rejoinder :- सल्यम् । यदापि विना वहि नीपलक्षी ध्मः, यद्यपि च पित्राचानारं नीपलस्वते तैयामनुपलस्थः, तद्यापि पित्राच- कार्यं एव धूमः। तय तव विद्वः कृतियत् सहितोः छपनिपतितः, रासभ दव,
न धूमस्य जनकः। तेन तदसावेऽपि तव्यातीय एव कारपनिद्वनमा
कदाचित् कादाचित्वी धूमः स्थात्। इति चनिव्यिते ग्रहायाः।
न च हृष्टसभावे नादष्टं कस्ययितुं युक्तम् इति अक्षः भवाद्वं कुम्। चनुपलक्षिणचयमाप्रस्य चशकानिराक रचलात् (vide Nyáya Vindu)। न च
चनुपल्ल्यान्तराचि चित्र तिविधि प्रभवन्ति। तक्षात् चनन्तरभेव इति
चवधारयाभावात् वैवः कार्याकारयभावावधारयं युक्तम्। न च यदयः
सहितानन्तरं छपल्यां तत्,तदन्तरिकात् तक्षात् भवत् भिन्नजातीयं भवति।
छक्षं दि रामभस्यदितात् वद्यः यादभी धूमः ताद्य एव तदरितात् वद्येरिति। तक्षादेवंविधा ग्रहापिशाची स्वनिवारकं तद्व्पितिवयमास्तन्दती
न शक्षा निवारयित्म्।

The Nyaya proceeds to point out that what is contingent need not necessarily be produced by a cause. It is enough if there is natural connection with something else, a relation of antecedence and succession (or concomitance), without any element of productive efficiency or causation.

भवि चान्तु तदुद्धितिययः तदाऽपि कस्तान् कारणमन्तरैय न काथै भवित । तथा च सति भन्गेचतया कादाचिन्कलिक्षिः इति चेन्। भन्तु तक्षि सन्त्रथः साभाविकतया भन्यानपेचः भव्यभिचारी समकलाहम्। स च यो वा स वा भवत्। कर्त कार्थकारणभावावभारपायासेन। यथा चेतन् तथा चये दर्शियणामः। Vāchaspati, Tātparyya-Tikā, Chāp, I, A'hnika 1, Sutra 5, व्यक्तियसेपायविकारः।

The Nyaya analysis of the causal relation continued: -Co-effects: -In the enumeration of different varieties of irrelevant antecedents ( पन्यान्ति ), we have already noticed that co-effects of the same Cause are apt to be confounded as cause and effect. In some cases, the co effects may be simultaneous, e.g., the case of the ascending and the descending scale in a balance, which are co-effects of gravity (vide Partha-sarathi Misra on Kumarila, Sloka Varttika-- तुलानमनीयमनयीस्त न नियः कार्याकारयत्नन, असवीरिककार-चलान,—sloka 157, Súnya-Váda). In other cases, the co-effects may be successive effects of the same cause, and here the risk is great of mistaking the antecedent co effect to be the cause of the succeeding co-effect ; e.g., the case of ants moving in a line to carry their eggs upward, which is observed before the summer rains ; - where the movement of ants and the rains are not cause and effect, but successive effects of the same cause, vic., the heat ( wur ), which disturbs the elements, viz., the earth and the atmosphere ( सदामृतचीम ); the ants being affected by this heat earlier than the atmospheric movements which bring the clouds and the rain.

(Uddyotakara, and Váchaspati—न च पिपीधिकाख-सञ्चरं नवंद्य कारयमनुषसञ्चसमर्थान्। सस्यपि तिकन् वर्षश्चीत्पत्तेः। वर्षमुखकारयस्य तु महामृतचीशस्य पिपीखिकाखस्यर्थः पूर्वकार्यम्। कथ्यमानाः सन्तु पिपीलिकः श्रीमेनी६वा खानि सञ्चानि मृमितानि चपरिष्टात् नयनि—Tátparyya—Tiká II, 2, Sutra 37).

Synchronousness of Cause and Effect.- This is resolved into a case of simultaneous co-effects of the same ultimate cause, e.g., the ascent of one scale and the descent of the other in the balance, which are not related as cause and effect, but are simultaneous effects of gravity. In other cases, the synchronousness is only apparent, the interval between the antecedent and the consequent being too small ( मुक्तकाल ) to be apprehended ( योगपदाधिमान ) e.g., in the case of the needle piercing a hundred soft lotus petals laid one upon another, where the steps are really successive; or the illumination of the whole room by the light of a lamp, where the succession is unperceived owing to the inconceivable velocity of light (cf. Kumarila, Sloka-Varttika,- इत्देत्मता विदं यीनपद्म-निदर्शनम्,- वत् प्रदोपप्रभाष्युतं, सूचाकाचीऽचि तत्र न:। दुर्खचन्तु यथा वेष: प्राप्या तथा । Sunyavada, Sloka 156-157 .-I quote Mimánsá authorities, but the view is common to the Mimansa and the Nyaya-Vaiseshika).

The time-relation in a chain of causes and effects :- A careful study of the time-relation in a chain of causes and effects is a peculiarity of the Vaiseshika system (and the later Nyáya). A moment (ultimate unit of time, Kshana, vu is defined to be the time-interval between the completion of the sum of conditions and the appearance of the effect. The Vaiseshika conceives the unit to be determined by reference to the division

The number of such units will determine the time-interval between a given set of physical conditions and a particular effect, for between a so-called sum of causes and a so-called sum of effects, there intervenes a series of atomic (or molecular) motions, with conjunctions and disjunctions which form the causal chain. However crude in the practical application, the fundamental idea is, in connection with the principle of work and energy (for which both the Sánkhya and the Nyáya-Vaiseshika furnish a rudimentary basis), immensely suggestive of a possible Time Calculus.

Plurality of Causes:—This will be discussed, when we consider the relation of Vyapti to the principle of Causality.

The Nyáya Ground of Inference—Vyápti formsiveti—Váchaspati):—Inference, then in the Nyáya, depends on the ascertainment, not of the casual relation, nor of the relation of genus to species, but of a natural relation, between two phenomena, of invariable and unconditional concemitance ( खपाधिविधर: सम्बन: ≪ाति:- Uddyotakara स्वाभाविक: and Vachaspati). Of the two phenomena so connected, one is called the Vyapya or Gamaka (the sign, mark or indicator), and the other Vyapaka or Gamya (the thing signified, marked, or indicated). In the relation of fire and smoke, for example, smoke is the Vyapya or Gamaka (sign or mark); and fire, the Vyapaka or Gamya the thing signified or marked). Now the relation of Vyápti between A and B may be either unequal equipollent विषयनव्याप्ति or समज्यापि ). When A is the sign of B, but B is not the sign of A, the Vvápti is one-sided or unequal, and here a Vyápti is said to exist between A and B, but not between B and A. For example, smoke is a sign of fire, but fire is not universally a sign of smoke. When, therefore, the relation of Vyápti is an unequal one, as between smoke and fire, it is expressed in the proposition :- Wherever the Vyápya (sign or mark, e.g., smoke) exists, the Vyápaka (the thing signified or marked, e.g., fire) also exists. From this it follows by necessary implication (a sort of waitsful) that whenever the Vyápaka (e.g., fire) is absent, the Vyápya (e.g., smoke) is also absent (व्यापकाभावे व्याणाभावः). Again the Vyápti may be a mutual or equipollent one, i.e., A and B may be signs of each other, e.g. green-woed fire and smoke. Here each in turn is Vyápya and Vyápaka, and this is expressed in

the two propositions :- (1) Wherever there is smoke, there is green-wood fire, and (2) wherever there is green-wood fire, there is smoke. By necessary implication it follows-(1) where there is no green-wood fire, there is no smoke: (2) where there is no smoke, there is no green-wood fire. We have seen that a Vyápti exists between smoke and fire, for wherever there is smoke, there is fire. But we cannot say that a Vyapti exists between fire and smoke, for we cannot say that wherever there is a fire, there is smoke. The combustion of an iron-ball ( प्योगीलक ), for example, is a case of fire without smoke. But it would be correct to say that a Vyápti exists between green wood fire and smoke, as well as between smoke and green-wood fire. The question, therefore, is-What is the relation between fire and smoke? The relation between fire and a conditional relation; i.e., condition that the fire is green-wood fire, it would be a sign of smoke. In other words, a Vyapti implies unconditional in variable concomitance, and the relation between fire and smoke is not therefore a Vyapti (natural unconditional concomitance), for fire requires a 'condition,' Upidhi. viz., green-wood, to be followed by smoke. Smoke, on the other hand, requires no 'condition' to indicate fire. For the purposes of Inference, therefore, relations between phenomena may

be considered as of two kinds:-(1) Contingent conditional relations, holding good on the fulfilment of a certain condition or Upádhi, and (2) unconditional Vyápti, or invariable relation. between a mark and that which it makes, a relation without any Upadhi or determining condi-( खपाचित्रिष्ठ: सम्बद्ध: ). It is this latter kind tion of relation that serves as the ground of Inference. If we can ascertain that a Vvapti exists between A and B, then A is a sign of B, and an inference of the presence of B from the presence of A, and of the absence of A from the absence of B, would be warranted. The question, therefore, is-how to ascertain the relation of Vyapti between two phenomena.

Ascertainment of Vyápti according to the early Nyáya (व्यक्तिपाय).—Briefly speaking, the observation of agreement in presence ( व्यव ) as well as agreement in absence (व्यक्ति ), between two phenomena, with the non-observation of the contrary (व्यक्तिपारायंग्य ). is the foundation of our knowledge of Vyápti ( द्यंगाद्यंग्य — Váchaspati). This suggests a natural relation (व्यक्तिपायंग्य — Váchaspati) of invariable concomitance ( व्यक्तिपायंग्य — Váchaspati) between the phenomena, which is fortified by our non-observation ( व्यक्ति ) of the contrary ( व्यक्तिष्य ). But this does not establish the unconditionality of the concomitance ( व्यक्तिव्यवस्थ ), which is essential to a Vyápti. We have therefore to examine the cases carefully

to see if there is any determining condition (Upádhi-i. e. some hidden or undetected but really operative or indispensable accompaniment) which conditions the relation between the supposed sign or mark (Gamaka) and the supposed signate (thing signified, Gymya). Now let us consider what constitutes an Upadhi. It is a circumstance which always accompanies, and is always accompanied by, the supposed signate (the thing signified, Gamya), but does not invariably accompany the supposed sign or mark (Gamaka). If, therefore, in the set of positive instances where both the sign and the signate are present, nothing else is constantly present, there can be no Upadhi. Or, again, if in the set of negative instances where both the sign and the signate are absent, no other material circumstance is constantly absent, there This follows from the very definiis no Upádhi. tion of an Upádhi. It is impracticable to fulfil these requirements rigorously. Still, every one of the accompanying circumstances (of course the likely ones) may be taken successively, and it may be shown that the concomitance continues even when the suspected Upádhi (अविशोपाधि) is absent, and therefore it cannot be the Upádhi, And this is to be fortified by the observance of uniform and uninterrupted agreement in absence (Vyatireka) between the two concomitant phenomena. In this way, when we have disproved all

suspected Upadhis, we conclude by establishing the Vyapti. It is true that we may still go on doubting. But doubt has a certain limit for the 'experimenter' and the thinking person (परीचक, पंचावान). doubt everthrows the foundation of all rational practice (बानायिकलीकयावा), or leads to a stoppage or arrest of all practical activity ( स्रोकव्यवदार ). it stands ipso facto condemned, and must (व्याधातावधिराम्हा). Sríbarsha abandoned and Udayana-আঘাৰ is mentioned by Váchaspati ). Thus it is that Vyapti is ascertained. In this way, we observe innumerable instances of Now by means of repeated observations of this kind ( सवीदर्शन ), we have established the principle of the Uniformity of Nature ( सामाय-प्रतिक्य ), and also of Causality; and these two principles thus ascertained may be made use of in their turn as the basis of an argumentation or deduction (Tarka, U'ha, नकं) to confirm a particular Vyapti in a particular case. Tarka or Uha, then, is the verification and vindication of particular inductions by the application of the general principles of Uniformity of Nature and of Causality, principles which are themselves based on repeated observation ( अयोदभीन ) and the ascertainment of innumerable particular inductions aniformity or causality ( भृथीदक्रेनजन्तिसंसकारसहितस र द्विनेव सामाविकसन्दर्भवादि-Vachaspati). Thus Tarka also helps in dispelling doubt ( सरेप ). Sriharsha,

however, questions the validity of this verification, the well-known couplet ending तक: महाविध: -cf. कृत: ।

It will be seen that the process of disproving all suspected Upadhis ( खपाधिमदानियास ), in the early Nyáya, answers exactly as a process to Mill's Method of Agreement. In fact, the disproof of a suspected Upádhi by pointing to instances of Agreement in absence ( पन्य ) even in the absence of the Upadhi, fortified as this is by the instances of agreement in absence ( व्यक्तिक ), virtually amounts to Mill's Joint Method of Agreement. But the fundamental difference is this :- Mill's Method of Agreement is formulated in view of the phenomena of causation (including co-effects, etc.) and, as usually enunciated, confessedly breaks down in dealing with cases of Uniformities of Co-existence unconnected with Causation; the Nyaya Method based on the disproof of suspected Upádhis is a more daring and original attempt, and is far more comprehensive in scope, being applicable to all Uniformities of Coexistence and of Causation alike. And this the Nyáya successfully accomplished, by introducing the mark of unconditionality ( चपाधिविश्वता ) into the relation of Vyapti (Concomitance), even as the same mark of unconditionality ( चनवाविद्युवता ) had been previously introduced into the definition of Causality (कार्यकारकभाव). The difference between the early Nyaya and the Buddhist systems

may be briefly put thus :- The former relied on empirical induction based on uniform and uninterrupted agreement in Nature, and accordingly the Method of Agreement regarded 2.5 fundamental Method of Scientific Induction. founding Inference on Vyapti to which they subordinated Causality in the doctrine of Method; the latter assumed two a priori principles, viz., causality and identity of essence, deduced the canon of the Method of Difference by an indirect proof from the principle of causality, and made this Method the toundation of all scientific Induction of Causality, just as they based all natural classification of Genera and Species on their a priori principle of Identity of Essence.

[Text from the early Nyaya :-

Method of Agreement and the Joint Method without the device of the Upadhi :-

Cf. Jayanta on साइचर्य-निकास सम्योग भवने न विना सबनं तत:। चयमेवाविनाभावी नियम: सहचारिता। 'तिकाम सम्योग' 'only this remaining throughout,' while others change—implying the Method of Agreement. The set of positive instances, in which this antecedent alone is constant, must be supplemented by a set of negative instances ( agreement in absence ):—व्यविद्यानवादिक प्रतिकाश्यक्षाद्वपपत्ते:। नियमपार्थ उच्चते यत् तकाम् स्ति भवनं वती विनाम भवनं इति भवनं वती विनाम भवनं इति भवीद्यानम् । तम् तक्षिम् स्ति भवनं इत्याव्यक्षाद्वप

परिच्छेदात् चर्बराष्ट्रीती नियम: सात्। तती विना न भवनं दलस चर्यस चपरिक्तेदान रति Javanta, A'hnika II, व्यतिरैकव्याप्ति-निषयावयाकत्म ।

Dectrine of the Upádhi :- Unconditional concomitance distinguished from conditional :-

थी वा स वा चम्त सम्बन्धः यस चनी स्वाभाविकी विवतः स एव नमकः. गम्य इतर: सन्दर्भीत युक्तते। तदा हि धमादीनां बङ्गादिसन्दर्भः साभाविक:। नतु बङ्गादीनां ध मादिभि:। छपलभाने ते हि विनापि व मादिभि:। यदातु चार्रस्थनादिसम्बन्धम् चतुप्तवनि तदा घुमादिभि: सह मंबध्यको। तथात् बङ्गादीनाम् पार्टेश्वनायपाधिकतः सम्बन्धी न स्वाभा-विक:। तसी न नियत:। साभाविकसु घुमादीनां वद्यादिसम्बन्ध छपाछ: यनुपलस्यमानात् कचित् व्यक्षिचारसः यदर्गनात् यनुपलस्यमानसादि कल्पनानुपपधिः। धती नियतः सम्बन्धः पनुमानाकृम्।

Concomitance sufficient without causal nexus :-

The Buddhist objects-In Nature, everything is connected with everything else. Hence if there were no nexus of causality between antecedent and consequent, everything might follow from everything else. The Nyaya replies-You admit uniformities (of co-existence, etc.) other than causal ;-so you confess that a natural fixed order can exist without causal nexus ......

An Upádhi, how established and how disproved :-

The Nyaya then proceeds to show how an Upadhi

is established, or how disproved by observation.—
तव करे: चनाईस्थनस्य दिना धूमद् चयोगीलकादी दर्भनात् चाईस्थनीपाधि: चस्य धूमिन सम्बन्धः न तु स्वामानिक इति निद्योवते । धूमिनिशेषस्य
तु दिना विष्ट्रम् चनुपलकात्, उपाधिमेदस्य च चहात्रमानस्य कत्यनायां
प्रमाणामानात्. विशेषस्थ्यपेषस्य च संश्रयस्य चनुपलस्यपूर्वे चनुत्पादात् चत्पादं च चित्रसङ्गत् प्रेचावत् प्रवृत्युक्टेदात्, स्वामानिकः
सम्बन्धः चवधार्यते ।

General Method of Induction by exhaustion of the Upadhi, more comprehensive than Mill's Joint Method:—

For the definition of an Upadhi, vide Sriharsha and Udayana: च्यावस्थान य: सम्बस्यापि: च्यावे स उपाधिरिति। Hence to avoid an Upadhi (which is सम्बस्यापि:), the constant presence of anything relevant other than the sign and the signate in the positive instances (of agreement in presence, च्या ), and the constant absence of any such thing in the negative instances (of agreement in absence, व्यक्ति ) must be safe-guarded against. This amounts to Mill's Joint Method.

Suspicion of non-perceptible Upádhi-Limits of legitimate Doubt :-

न च चहक्रमानीऽपि दर्मनानर्शतया साधकवाधकप्रमाणाभावेन संदिक्तमान स्पाधिः साभाविकत्वं प्रतिवधाति इति साम्प्रतम्। चवक्यं बह्या भवितन्यं नियासकाभावादिति दक्तावकामा खलु इयम् समाचमर्व्यादातिकसेन बहा पिषाची संभ्यतस्या न कचित् नासीति नेयं

कचित् प्रवर्धेत । सळेतेव कस्तचित् कर्याचत् भन्धेस प्रकासदलात । चनवंश्रद्वायाय प्रेचायता निरुक्तद्वलात्। चलतः स्थित्वाद्वपानीप्योतिव चित सरवादिदर्शनातः तथात प्रामाधिकशीकशाताम् चनुपालयता व्यादर्भनं शङ्कीयम्।.....तकःदुपाधिं प्रयटेन चन्त्रियन्तीऽनुपलसमाना नाकीति चनगम्य खाभाविकलं सम्बन्धसः निवित्तमः।---

Tarka, U'ha,-Deductive verification of particular inductions by applying the two fundamental inductions of Uniformity of Nature, and Causality :- Doubt finally dispelled :-

Now innumerable particular uniformities of this kind (Vyaptis) are observed, and as a result of this repeated observation, a belief in the Uniformity of Nature ( अभावतिवस ), as well as in the principle of Causality ( कार्यकार्यभाव ) is generated in the mind, a belief which has evidential value and validity. It is not intuition ( न सानसम् ) but a mental pre-disposition based on uniform and uninterrupted experience ( भूयोदर्भनजनितसंस्कारसन्दितम् इन्द्रियमेव साभाविकसम्बन्ध याहि,—भव भूबोदर्भनम् घसाधारवम् प्रति वस्।वानः आतम् ). Then armed with these new resources, the belief in uniformity and in causality as general principles, we proceed to fortify our particular inductions ( Vyaptis ), whether of uniformity of nature or of causality, by indirect deduction from these general principles :- We argue if, under these observed circumstances, A were not the mark of B, the principle of uniformity of nature would be violated,-Nature would not be uni-

Instances of Vyapti (uniformity) not comprehended under Causality, or the relation of Genus and Species :- The Nyaya points out that the relations of cause and effect and of genus and species do not exhaust the grounds of Inference. There are cases of Inference based on Vyapti (i. e., on invariable and unconditional concomitance) which come neither under Causality (तद्वपति ) nor under Identity of Essence ( तादाका ). Váchaspati notes that to-day's sunrise and vesterday's sunrise, the rise of the moon and the tide in the ocean, the relative positions of the steller constellations, are instances of Vyápti (invariable concomitance) between phenomena which are neither related as cause and effect, nor as genus and species. Jayanta adds the conjunction of sun-set with the appearance of the stars,

of ants moving in procession (with their eggs) with the approach of the rains,—of the rising of the constellation Agastya (Canopus) above the horizon with the drying up of rivers; of the spring tide with the full moon; and dismisses as sophistical and far-fetched the Buddhist attempt to explain all these cases by means of causality. We have seen that the Nyáya and the Mimánsá reduce most of these conjunctions to cases of co-effects of the same cause, co-effects which may be either simultaneous or successive.

चिष चयातनस्य स्वितुद्दस्य श्रास्तेन स्वितुद्द्दीन, चन्द्रोद्यस्य च समानकालिन समुद्रश्या.....न कार्यकारचभावः तादाकां वा । चयच दश्ची स्वयमकभावः ।—Váchaspati, Tátparyya-tíká, I, I, Sútra 4;—Cf. also Jayanta, Nyáya Manjarí—चन्नेवासिय छन्नां भूवां भगति दर्शनात् । मूर्यास्त्रमयमालीस्य कस्यते तारकीद्यः । पूर्यचन्द्रीद्यादृद्धिरम्प्रेशवगस्यते । स्वितेनानुमीयने सरितः सुन्ध्योगिनः । पूर्यचन्द्रीद्यादृद्धिरम्प्रेशवगस्यते । स्वितेनानुमीयने सरितः सुन्ध्योगिनः । प्रयाप्तिनपर्यते विद्यानस्वयंत्रयः । प्रयोगिकास्यस्यारचेशानुनित्रस्यः । भवनि प्रयक्ताः प्रयोग्नेवराः ।

Vyápti between Cause and Effect:—Relation of causality to Vyápti:—

On the Buddhist (and early Nyáya) view that one specific assemblage of 'effect' phenomena has one specific assemblage of causal conditions, there would be two aggregates, the sum of causal conditions ( कार्यकार्थों), and the sum of effects ( कार्य-समयों). For example, fire requires green-wood to complete the sum of causal conditions to give rise to smoke with some particular marks ( क्रिकेश्न-

वश्रुवपाख्रुवाद्विश्कृतिशिष्ट, Jayanta II ; compare Gangesa कचानुस्प्रभवविष्मानधं कट्कासुरक्षिपाच्यरघु स्वच्यात् ।— Chintámani, Anumana, Viruddha Siddhanta). Here, between an effect and a single condition ( termed a cause ) there is a relation of Vyapti. The effect is Vyapya or Gamaka (the sign or mark) ; the cause (or condition) is Vyapaka or Gamya (the thing signified). In other words the presence of the effect indicates the presence of the causal condition, and the absence of the causal condition will by implication indicate the absence of the effect. Smoke of this particular kind is supposed to be an effect of which there is one and only one assemblage of causal conditions (fire and green-wood); hence where there is smoke, there is fire; and when there is no fire, there is no smoke.

Now introduce the complication of the plurality of causes : - Fire, for example, is the effect of several assemblages, e. g, (1) blowing on heated grass, (2) focussing rays through a lens on a combustible like paper or straw, (3) friction with the fire drill, etc. Here each assemblage is regarded as a sum of causes. But in this case there is no Vyapti between the effect 'fire' and any particular assemblage of causal conditions, say, of the lens or the fire drill. For the presence of fire does not indicate the presence of the lens or the fire drill assemblage, nor does the absence of either of the latter in particular, indicate the absence of fire. Indeed in such a case, the effect 'fire' is not a mark or sign ( Gamaka or Vyápya ) of any one in particular of the different possible causal assemblages, though each of these particular assemblages of causal conditions is a mark or sign ( Gamaka or Vyápya ) of fire.

The plurality of causes requires a further consideration in the light of the definition of the causal relation. A cause is defined to be the unconditional invariable antecedent. From the unconditionality, it follows that the entire sum of conditions, and not one single condition, is, properly speaking, the cause. In view of the plurality of causes, an invariable antecedent must be taken to mean that any particular cause (i.e., assemblage of causal conditions) is invariably followed by the effect,—not that the effect is invariably preceded by any particular cause.

Popularly, a single condition, say the lens or the fire-drill, is said to be a cause of fire; but, in view of the plurality of causes, this is apt to be misleading, as there is no Vyápti in this case: the lens or the fire-drill is no more a mark of fire than fire is a mark of the lens or the fire-drill.

The plurality of causes strains the definition of a cause, and undermines the relation of Vyapti between an effect and a cause. Any particular cause (causal aggregate) still indicates the effect, but not vice versa. The earlier Nyaya (down to

Váchaspati and Jayanta ) obviated the plurality, as we have seen, by introducing distinctive marks in the effect such as would indicate a single specific cause (कार्यां वेलच्या or कार्याभेद indicating कार्यावेलच्या or कारसमेद ). Some indeed went further and held that when the antecedent causal assemblages differ in kind, the effect phenomena, though apparently the same, do realy differ specifically ( or in kind) - कारकवेत्रात्यान कार्या वेत्रात्यम् । But the Nyáya diseards this hypothesis; the fire is the same, though the possible causes (or causal aggregates) differ, e. g., the lens, the drill, etc. But the effect phenomenon to which we attend is not the only effect ;-in the case of plurality of causes, we must carefully examine the accompaniments of the effect, i.e., the sum of effects, and the examination will shew some distinctive or specific circumstance or accompaniment which will enable us to definitely determine the particular assemblage of causal conditions that must have preceded in the case under examination. This is the device of the earlier Nyaya as well as of the Buddhists, as we have seen; but the later Nyava doubts the practicability as well as the theoretical validity of such a step on an unrestricted assumption of the plurality of causes, and feels troubled by the circumstance that no effect for which more than one cause (or causal aggregate) can be assigned, can be regarded as a mark or sign (Gamaka or Vyápya) of any one of

the causes in particular. Accordingly, adherents of the later Nyaya advanced the proposition that when more than one causal aggregate can be supposed for any effect, the latter is a mark or sign (Gamaka or Vyapya), not of any one of the causal aggregates in particular, but of one or other of them; and the absence, not of one such cause, but of each and every one of them, alone indicates the absence of the effect. A cause therefore should be defined to mean one or other of the possible alternative aggregates which, being given, the effect follows invariably and unconditionally. If we ask what is the defining mark (or quiddity) of the cause ( जारदनाव चंदन ), we are told that it is one-or otherness ( पन्तनन ), and nothing else; others cut the Goridan knot by assuming that the different possible causes of the same effect possess a common power or efficiency (प्रतिरिक्तमिक्त), or a common 'form' (कार्तिसीचा). which accounts for the production of a common effect. The latter is therefore a sign or mark of this power ( afa ), or this form ( affaelat), which is manifested by each of the causal aggregates. This hypothesis ( कसना ), they hold, is simpler and more plausible than the hypothesis of specific differences latent in the apparently identical effect of a plurality of causes (कारववेत्रावात कार्यवेत्रावान् ).

(Cf. Dinakari on the Siddhanta Muktavali — केचिन् बिक्रं प्रति स्थलनुकार-सेवानादीना स्थलनुकारसेवासनादिक्येच कारणतया व्यक्तिणारिय चसकात् प्रतिरिक्तप्रक्रिसिद्ः। न च उच्छुत्कारयीः चरणिनमेन्द्रेयाः सध्यर्गणिकरण्यीय सम्बन्धः अन्यतावच्छेदवं वित्रविक्तिकात्वयदं कट्यामिति न व्यक्तिणार इति वाच्यम् । तन्यन्यतावच्छेदकवैकात्वययकस्यनामपेच्य तत्तत्वच्यभागं एकप्रक्रिमत्वेन कारणतकस्यनाया एव अपुर्वेन नात्यनात् इत्याष्टः। तदः।...चन्तमत्वेन कारणतास्थ्यवात्......परे तु द्रचादिस्यक्षमाचीनवायुक्तयीगादीनां एक-व्यक्तिमत्वेन चेतुतामादाय विनित्यसमाविरदात् न प्रक्रिक्तिस्यम्। Sloka 2, cf. also, द्रचारणिकस्यक्तसम्यं कारणस्य विनित्यसम्।

Cf. Udayana, Kusumán jali, Stavaka 1— कर र हिं
द्वारिक विश्वा स्वत्राय प्रविद्वा स्वत्राय क्षित्र त्यारिक विश्वा स्वत्र स्वत्र विश्वा स्वत्र स्वत्य स्वत्र स्वत्य स्वत्र स्वत्य स्वत्र स्वत्य स्वत्य

The Scientific Methods already noticed, the Joint Method of Difference (the Panchakarani), and the Joint Method of Agreement (Vyaptigraha with Upadhisanka-nirasa and Tarka), are not the only methods of ascertaining causality or concomitance, or establishing a theory (fegure); nor are these Methods always practicable. Very often, we reach the explanation of a fact (equiv) by means of a Hypothesis (equiv) properly tested and verified (frage.). A legitimate Hypothesis must satisfy the following condition:—(1) the hypothesis must explain the facts (except, or equiv; (2) the

hypothesis must not be in conflict with any observed facts or established generalisations ( दर्शक्य हि बट्ट कलाने, न इटविशासाय-Jayanta, Nyaya-Manjari, A'hnika 1); (3) no unobserved agent must be assumed, where it is possible to explain the facts satisfactorily by observed agencies ( यदि घट्टमनारेव हर्ष्ट न विद्याति काममहर्ष्ट करुपताम, अन्यवार्द्ध वद्यपत्ती किं सद्यक्तानेन, ibid); (4) when two rival hypotheses are in the field, a crucial fact or test (विनियमक, ratio sufficiens) is necessary; the absence of such a test ( विविधमनाविद्य ) is fatal to the establishment of either, (5) of two rival hypotheses, the simpler, i.e., that which assumes less, is to be preferred (ccteris paribus) (कलनानाघव versus कलाबीरव ) ; (6) of two rival hypotheses, that which is immediate or relevant to the subject-matter is to be preferred to that which is alien or remote प्यमीपिखतन ); (7) a hypothesis that satisfies the above conditions must be capable of verification ( निर्णय ) before it can be established as a theory ( fegree ). The process of verification of a hypothesis consists in showing that it can be deduced as a corollary from (or is involved by implication in some more general proposition which is already well-established (cf. Vatsyayana's exposition and illustration of Verification, निर्मय -including both the Deductive Method and Colligation).

This doctrine of Scientific Method, in Hindu Logic, is only a subsidiary discipline, being com-

prehended under the wider conception of Methodology, which aims at the ascertainment of Truth whether scientific (Vijnana) or philosophical (Jnana) ( मोचे धीर्यानम् कात् विद्यानं विकासको:, Amara-Kosha) :-the latter being the ulterior aim. In the invest igation of any subject, Hindu Methodology adopts the following procedure . (1) the proposition (or enumeration) of the subject-matter (Uddesa), (2) the ascertainment of the essential characters or marks, by Perception, Inference, the Inductive Methods, etc. - resulting in definitions (by was) or descriptions (by suwas); and (3) Examination and Verification ( परोचा and निषय)-Ordinarily the first step, Uddesa, is held to include not mere Enumeration of topics, but Classification or Division proper ( विभाग: सद्देशस्यानपायामु सदय एवासी। सामान्यसंत्रवा कोर्श्वश्रम्भद्देशः प्रकारमेदसंत्रवा कीर्शनं विभाव ₹fa-Jayanta, Manjari); but a few recognise the latter as a separate procedure coming after Definition or Description. Any truth established by this three-fold (or four- ild) procedure is called a SiJdhanta (an established theory). Now the various Pramanas Proofs, i.e., sources of valid knowledge) in Hindu Logic. viz., Perception, Inference, Testimony, Mathematical Reasoning ( 544 including Probability in one view) are only operations subsidiary to the ascertainment of Truth (तस्त्रविष्य). And the Scientific Methods are merely ancillary to these Pramanas themselves.

I have explained the principles of the Hindu doctrine of Scientific Method, avoiding the technicalities of Logic as far as possible; and I cannot here enter upon the logical terminology or the logical apparatus and machinery, which would require a separate volume to themselves. For these, I would refer the reader to my paper on Hindu Logic,-as also for an account of the later Nyáya ( अध्यक्षात् ), which, in spite of its arid dialecpossesses a three-fold significance in the history of thought: (1) logical, in its conceptions of Avachchhedaka and Pratiyogi, being an attempt to introduce quantification on a connotative basis. in other words, to introduce quantitative notions of Universal and Particular, in both an affirmative and a negative aspect, into the Hindu theory of Inference and Proposition regarded connotatively as the establishment of relation among attributes or marks : (2) scientific, in its investigation of the varieties of Vyápti and Upádhi, (and of पनकाश्वर ) being an elaboration of Scientific Method, in the attempt to eliminate the irrelevant; and (3) ontological and epistemological, in its classification and precise determinations of the various relations of Knowledge and Being, with even greater rigidity and minuteness than in Hegel's Logic of Being and Essence. I will conclude with a few observations on Applied Logic, i.e., the logic of the special sciences, which is such a

characteristic feature of Hindu scientific investiga-What is characteristic of the Hindu scientific mind is that without being content with the general concepts of Science and a general Methodology, it elaborated the fundamental categories and concepts of such of the special sciences as it cultivated with assiduity, and systematically adapted the general principles of Scientific Method to the requirements of the subject-matter in each case. The most signal example of applied logic (or Scientific Method) worked out with systematic carefulness is the Logic of Therapeuties in Charaka, a Logic which adapts the general concepts of cause, effect, energy, operation, etc., and the general methodology of science to the special problems presented in the study of disease, their causes, symptoms and remedies (vide Charaka, Vimánasthána, Chap IV.also Sutra Sthána, - vide my Paper on Hindu Logie). Here I will give an illustration of Applied Methodology from the Science of Analytical and Descriptive Grammar, Patanjali, in the Mahábháshya, (Circa 150 B. C.) is very careful as regards Methodology. I take no note now of the philosophical presuppositions of his philology (vide my Paper on the Hindu Science of Language), but will confine myself to his presentation of the Applied Logic of Descriptive and Analytical Grammar. The sentence is the unit of speech, as every Hindu philologer contends, but the first business of Analytica

Grammar is to analyse the sentence into its significant parts and their coherent relations to one another. Assuming that articulate sounds are significant, the question is .--how is the sentence, which is the unit of articulate speech, broken up into significant words and their mutual relations? Patanjali answers that this is done by an instinctive use ( cf. Váchaspati's भूकी दर्भन प्रतितसंस्थारन प्रन्दियम् ) of the Joint Method of Difference (combined Addition and Subtraction), fortified by the Joint Method of Agreement ( 444-Patanjali starts with a simple case. स्वतिरेकी ). Take the two sentence-units :- Pathati (he reads) and Pachati (he cooks', Suppose you start with the assumption that these sounds are ficant, and that separate elements have separate meanings. Then you hear Pathati, and, at the same time, a man reading is pointed at. Then the assemblage of sounds Pathati (i. c., Path+ati) stands for the assemblage-'one reads,' (i. e. the Similarly action reading + an individual agent). by finger-pointing or other indication, you find that the assemblage Pachati i. e., Pach+ati) stands for the assemblage 'one cook's (i. e. the action cooking +an individual agent, say, the same agent as before),

Now look at the grouping :-Path + ati - reading + one agent. Pach +ati - cooking + one agent.

From repeated observation of similar groupings, one is led to conclude that path is the invariable concomitant of the action 'reading', because the disappearance of the formar (the other element remaining) leads to the disappearance of the latter ( a rough Method of Difference by subtraction—होवते); that Pach is the invariable concomitant of the action 'cooking' because the introduction of Pach (with nothing else added) leads to the introduction of the action 'cooking,' (a rough Method of Difference by addition,—उपनावते); and that Ati, which is the only 'common antecedent' ( अवधी ) . is the invariable concomitant of 'one agent' which is the only common 'consequent' ( भन्दी ). fact, the last should come first by the Method of Agreement, then the other two either by Residue, or by Joint Agreement in presence and absence ( भन यव्यक्तिको ). So far all is plain sailing, though only very simple and very rough applications of the Methods are given. But-and this is the point-throughout the argument, it is assumed that one sound is the concomitant of one idea, in other words, there is no plurality of causes to vitiate the application of the Method of Agreement in the above example. And now the objection is advanced that this basal assumption is untrue. The same sound is not the concomitant of the same idea. Different words (sounds) may have the same meaning, and the same word (sound) may have different meanings. We cannot therefore by the Joint Method of Agreement ( पन्यव्यक्तिरेको ) determine the meanings of words, or the separate functions of roots (stems) and inflections,-at least not so simply as is pretended above. Patanjali states this difficulty in the way of applying the Scientific Methods to the problems presented by Analytical Grammar, a difficulty arising from the plurality of causes, but does not state the solution. solution, however, depends on the Method of subtraction and addition (Patanjali's कीयते and For it will be found by extensive उपनायने ). observation that the number of meanings of which a word (sound) may be capable is limited. So also is the number of words (sounds) expressive of a given Hence, by the Method of Difference. meaning. etc., the causal relations of words and meanings may be determined. Patanjali thus established the doctrine of Prakriti and Pratvaya (roots and inflictions), with their separate significance, which is of course a necessary postulate in the case of an inflectional language like Sanskrit. Isolating and Agglutinative languages offer less difficulty. whereas the difficulties are in some respects enhanced in the case of languages with a polysynthetic or incorporating (incapsulating) morphological structure.

क्यं प्रभन्नां वते भयं प्रक्रवार्थः भयं प्रव्यवार्थं इति । भव्यव्यविरिकाश्वाम् कोऽसी भव्ययो व्यक्तिरेकी वा। इह पणतीसुक्ती कवित् प्रव्यः स्थते, पटती बुक्ते कियत् शब्दी की वर्त (पच्),—कियत् छपत्रायते (पट्),— कियत् भन्यी (पति);—पर्योऽपि कियत् कीयते (विक्रित्तः),— कियत् छपत्रायते (पिठिकिया),—कियत् भन्यो (करूलं चैकलंच)। तैन सन्यासकी यः शब्दी कीयते. तस्य भन्नी पर्थः थीऽयाँ कीयते। यः शब्द छपत्रायते तस्य भन्नी भर्यः योऽये छपत्रायते। यः शब्दोऽन्यशै तस्य भन्नी भर्यः योऽयोऽन्यशै।

विषम उपन्याम:—वहवी हि मन्दा एकाथों भवनि । तद्यथा इन्द्रः मकः पुरन्दरः । एकच मन्द्रो वहथैः । तद्यथा प्रचाः पादा भाषा इति । षय वि न साधीवीऽर्धवना सिद्धा भवति । नापि वृत्तीऽर्धवना व सिक्ततीति । वर्षिता हि धर्यवना धन्यव्यतिरैकाम्यामेव । तत्र कुत एतद्यं प्रक्रयथैः धर्यं प्रक्षयार्थं इति । (Mahábhsáhya, 1—3, 9, )

Patanjali not only applies the Scientific Methods to the foundations of Grammatical Analysis. but also by their means establishes and elaborates the fundamental categories and concepts of Grammatical (and Philological) Science, e. g., the concepts of action ( किया ), agent ( कर्मा ), instrumental cause ( करव साधकतमम् ), end ( निमित्त ), origin ( ईतु ) limit ( अवधि ) substance ( इज ), quality ( नुष ), and genus ( जाति ) ; -also of the fundamental relations (at the bottom of all thought and speech )-the relations (कालिकसम्बर्ध), of space (दिग्देशसम्बर्ध), of Time of causality (कार्यकारकभाव), of inherence (समकाय), of co-inherence (सामापाधिकरका), of substance and attribute ( विशेषणाविशेषामान ), of the sign and the signate ( संचारंचिभाव ), of mutual dependence ( इतरेतरायय ) ; an entire grammatical (and philological) apparatus, wnich will serve as a point d'appui' for generations of philologists and grammarians to come.

### ADDENDA.

### (BY PRINCIPAL BRAJENDRANATH SEAL.)

Empirical Recipes from Varahamihira (circa 550 A.D.) relating to Chemical Technology.

A. Searing of hard rocks to enable them to be cut (or pulverised) ( fuergree ).

Sprinkle on the rock taken red-hot from the fire of Palasa and Tinduka wood (Butea Frondosa and Diospyros Embryopteris):—(a) diluted milk, or (b) a solution of wood ashes (the ashes of the Mokshaka mixed with those of reeds), or (c) a decoction of (the fruit) of the jujube (Zizyphus Jujuba) kept standing for 7 nights in a mixture of whey, vinegar and spirits, in which Kulattha (Dolichos Uniflorus or Biflorus) has been steeped, or (d) a solution of the ashes of the Neema bark and leaves (Azadirachta Indica', the sesame pod, the resinous fruit of the Diospyros Embryopteris, and the Guduchi (Tinospora Cordifolia) with cow's urine. Repeat the process seven times (in the last case six times).

(Varabamihira, Vrihat-sanhitá, Chap. 33, Slokas 112-117).

- B. Hardening of steel ( ऋखपान ).
- (1) Plunge the steel red-hot into a solution of plantain-ashes in whey, kept standing for 24 hours; then sharpen on the lathe.
- (2) Make a paste with the juice of the Arka (Calotropis Gigantea), the gelatine from the horn of the sheep, and the dung of the pigeon and the mouse; apply it to the steel after rubbing the latter well with (sesame) oil. Plunge the steel, thus treated, into fire; and when it is red-hot, sprinkle on it water, or the milk of the horse (or the camel or the goat), or ghee (clarified butter), or blood, or fat or bile. Then, sharpen on the lathe.

(Varáhamihira, सहस्वस्य, chap. 49, slokas 23-26.

C. Preparation of cements (for rocks, metals, etc.) ( বৰ্ত্তীৰ )—

Varáhamihira gives the following recipes among others. (1) First, prepare a levigated powder with lac, the resinous exudation of the Pinus Devadara, the Balsamodendron Mukal, the Feronia Elephantum, the kernel of the fruit of the Ægle Marmelos (the bel), the Diospyros Embryopteris, the Neem (Azadirachta Indica), the Mhow (Bassia Latifolia), the Indian madder (Rubia Manjistha), the Phyllanthus Emblica, and the resin of the Sala tree (Shorea Robusta), then make a decoction of this in 256 Palas of water reduced

by boiling to 32 Palas, and apply the decoction hot.

- (2) The horns of cows, buffalos and goats, asses' hair, buffalo's skin, with gavya (cow's urine etc.), the Neem (Azadirachta Indica) and the Feronia Elephantum, similarly treated.
- (3) A mixture of eight parts of lead, two of 'bell-metal' and one of brass, melted and poured hot (Maya's cement).

The first, it will be seen, has lac, gum and turpentine as principal ingredients, the second makes use of gelatine, and the third is a metallic cement.

D. Nourishment of Plants :— (from Varáhamihiria, Chap. 54, on squae ).

The most suitable ground to plant in is soft soil that has been sown with the Sesamum Indicum, and dug up or trodden over with the sesame in flower. Grafts should be smeared with cowdung. For transplanting, the plants should be smeared with ghee (clarified butter), sesame oil, the honey of the Kshudra variety of the bee, the oil of the Usira (Andropogon Laniger or Andropogon Citrarum), the Vidanga (Embelia Ribes), milk and cowdung. Trees should be planted at intervals of 20 or 16 cubits.

As a sort of general prophylactic, mud kneaded with ghee (clarified butter) and Vidanga, (Embelia Ribes) should be applied to the roots, after which milk diluted with water should be poured. As a remedy against barrenness, a hot decoction should be made of Kulattha (Dolichos Uniflorus or Biflorus), Masha (Phaseolus Roxburghii), Mudga (Phaseolus Mungo), Tila (Sesamum Indicum), and Yava (barley); which, when cooled, should be poured round the roots.

To promote inflorescence and fructification, a mixture of one A'dhaka (64 palas) of sesame, two A'dhakas (128 palas) of the excreta of a goat or sheep, one Prastha (16 palas) of barley powder, one Tula (100 palas) of beef, thrown into one Drona (256 palas) of water, and standing over for seven nights, should be poured round the roots of the plant. The measures given are for one plant.

To ensure inflorescence, etc., the seed before being sown should be treated as follows:—The seeds should be taken up in the palm greased with ghee (clarified butter), and thrown into milk;—on the day following, the seeds should be taken out of the milk with greased fingers, and the mass separated into single seeds. This process is to be repeated on ten successive days. Then the seeds are to be carefully rubbed with cowdung, and afterwards steamed in a vessel containing the Aesh of hogs or deer. Then the seeds are to be sown with the flesh, with the fat of hogs added, in a soil previously prepared by being sown with sesame and dug up or trodden down.

To ensure the formation of Ballaris (i.e., sprouting and the growth of luxuriant stems and foliage), the seeds should be properly soaked infusion of powdered paddy, Masha (bean), sesame and barley mixed with decomposing flesh, and then steamed with Haridra (turmeric). This process will succeed even with the Tintidí (Tamarindus Indica). For the Kapittha (Feronia Elephantum), the seeds should be soaked for about two minutes (lit. such length of time as it would take one to make a hundred rhythmic claps with the palms steam in a decoction of eight roots (A'sphota, A'malaki, Dhava, Vasika, Vetasa, Suryyavalli, Syama and Atimukta, i.e., the Jasmine, the myrobalan, the Grislea Tomentosa, the Justicia Ganderussa, the Calamus Rotang, the Gymandropsis Pentaphylla, the Echites Frutescens, and the Dalbergia Oujeinensis) boiled in milk. The seeds should then be dried in the sun. This process should be repeated for thirty days. A circular hole should be dug in the ground, a cubit in diameter and two cubits deep, and this should be filled with the milky decoction. When the hole dries up, it should be burnt with fire, and then pasted over with ashes mixed with ghee and honey. Three inches of soil should now be thrown in, then the powder of bean, sesame and barley, then again three inches of soil. Finally, washings of fish should be sprinkled, and the mud

should be beaten and reduced to a thick consistency, then the seed previously prepared should be placed in the hole under three inches of soil, and fish-washings poured. This will lead to luxuriant ramification and foliage, which will excite wonder. The Agnipurana adds that the mango is specially benefited by cold fish-washings ( अनुस्थित क्षेत्र भाषा कि स्थान-इव्युष्ट , Agnipurana). It will be seen that these elaborate recipes are empirical contrivances for supplying the requisite nitrogen compounds, phosphates and bacteria, these being potentially contained in the mixtures and infusions prescribed.

## SANSKRIT TEXTS.



# Extracts from RASARATNAKARA.

नागार्ज्जुन-विरचितात्

रसरत्नाकरादुषृताः स्रोकाः।

भय महारसगोधनं व्याख्यास्यामः । किमत्र चित्रं यदि राजवत्तेकं ग्रिरीषपुष्पायरमेन भावितम् । सितं सुवर्णं तक्षाकं मित्रभं करोति गुद्धाग्रतमेकगुद्धया ॥ १ ॥ राजावसंगोधनम् ।

किमच चित्रं यदि पौतगन्धकः पलायनिर्व्यासरसेन ग्रोधितः। प्रारख्यकै इत्यलकैस्तु पाचितः करोति तारं विपुटेन काश्चनम्॥२॥ गन्धकप्रदिः। किमत्र चित्रं रसको रसेन

• • • • ।

क्रमेण कत्वाम्बुधरेण रिख्यतः

करोति ग्रल्वं त्रिपुटेन काश्वनम् ॥ ३ ॥ •

रसकगोधनम ।

किमत्र चित्रं दरदः सुभावितः पर्यनि मेष्या बहुगोऽस्ववर्गेः । सितं सुवर्षे बहुवर्मभावितं करोति साचाहरकुहुमप्रभम् ॥ ४ ॥ दरदश्वहः ।

कुलत्यकोद्रवकाये नरमूत्रेण पाचयेत्। वितसाद्यन्तवर्गेण दस्वा चारं पुटत्रयम् ॥ ५ ॥ किमत्र चित्रं कदलीरसेन सुपाचितं स्रणकन्दसंस्यम् ।

Agrees nearly with Rasárnava; cf. Vol. I. Sans.
 Texts, p. 13.

<sup>†</sup> quer is the correct form.

वातास्तिलेन छतेन ताष्ट्यं पुटेन दर्श्वं वरग्रुविमिति ॥ ६ ॥ साचिकशोधनम् ।

हिगुणा विसना पथ्या रखातोयेन संयुता । नवणैवैकै दुग्धेन ताम्त्रपत्नाणि सैपयेत् ॥ ८ ॥ यम्नो सन्तप्य निगुण्डीरससिक्तानि सप्तधा । सामान वसुरसेनैव ग्रल्बग्रहिभैविष्यति ॥ १० ॥

परतः सर्व्यकोष्ठयोधनम् । चन्त्रवेतसधान्यान्त्रमेषोतोयेन ग्रध्यति ॥ ११ ॥ विसलग्रहः ।

चपलाद्या धातवः मर्व्यं जम्बोररसभाविताः। गोधितास्त्रिदिनं पश्चमः सिकाभस्मलावणैः। संयुताः संगोधयन्ति पुटपाकेन काश्चनम्॥ १२॥ इसगोधनम्।

नागेन चारराजेन भाषितं ग्रहिस्च्छति ।

<sup>.</sup> The text reads um, which is incorrect.

<sup>†</sup> This verse also occurs in Rasárnava.

तारं व्रिवारनिचिप्तं पिशाचीतेलमध्यगम् ॥१३॥ तारग्रहि:।

घडो नु चित्रं पृथिवीभवेन
चारेण मेथीपयसा एतेन।
तेसेन ग्रडं द्तयोड्गांगं
भवेच ग्रस्वं ग्रिश्यक्तसित्रभम्॥१४॥
मोचमारीटपालाग-चारगोम्नूचभावितम्।
वज्रुकन्दशिखाकल्क-फलमूलसमन्वतम्॥२३॥
तत्कल्कं कप्टकं साचाचूणे वैकान्तसम्भवम्।
सारघेण समायुक्तं मेथयक्त्रीद्रवान्वितम्॥२४॥
पिक्तितं सूकसृषास्यं धामितच्च इठाम्बिना।
तत्वेव पतते सत्त्वं वैकान्तस्य न संग्रयः॥२५॥
वैकान्तसस्यम्।

चौद्रं गन्धर्क्वतैनं सष्टतमभिनवं गो रसं सूत्रकञ्च

These couplets also occur in R. R. S., with this difference that in the latter \*\*\* that been substituted for urcu.

भूयो वातारितेलं बदिलरसयुतं
भावितं कान्तितसम् ।
भूषां कत्वास्मिवर्णामस्यकरिनभां
प्रचिपेकाचिकेन्द्रं
सस्वं नागेन्द्रतुष्यं पतित च;सइसा
सूर्यंवैक्षानराभम् ॥ २५ ॥ \*

महाहचार्वचौराभ्यां स्त्रीस्तन्येन सुभावितम्।
मूषायामम्नवर्षायां द्रवेत्ताप्यं न संगयः ॥२६॥
कङ्गुष्ठटङ्गणभ्याच ताप्यं स्त्रीस्तन्यमहितम्।
पद्माव्यस्यं निपतित सत्यं मूषा तु प्रस्निवत् ॥२०॥
काञ्चिकं बङ्ग्यस्त्रिकं ताप्यच्यं कट्ठिकम्।
कत्वाम्युमधभ्यां पक्षं वजुपायसभावितम् ॥२८॥
ग्रह्मध्रमं प्रतं चौदं संगुतं पुनरेव च।
धामितं सूकमूषायां प्रशिग्यस्त्रिनमं भवेत् ॥२८॥
कदलौरसग्रतभावितं प्रतमध्वेरस्वतेलपरिपक्षम्।
ताप्यं सुचितं सत्त्वं रसकच्चेव विसङ्गाते ॥३०॥
माचिकसस्वपातनविधः।

Cf. Rasárnava, Vide Sans. Texts, Vol. I., p. 12

चारस्रेहेथ धान्यास्ते रसकं भावितं वहु।
कर्णा लाचा तथा पष्या भूलता धूयसंयुतम् ॥३१॥
सूकसूषागतं धातं टङ्गणेन समन्वितम्।
सन्तं कुटिलसङ्गागं पतते नात्र संगयः॥ ३२॥ \*
रसकसन्तम्।

विमनं शिय्तीयेन काचीकासीसटङ्कणैः । वजुकन्दसमायुक्तं भावितं कदनीरसैः ॥ ६५ ॥ माचीकचारसंयुक्तं धासितं सूकसूषके । मत्त्वं चन्द्राकंसङ्कार्यं पतते नाव संग्रयः ॥ ३६ ॥ १

दरदं पातनायन्त्रे पातितश्च जनायये । सन्त्रं सूतकसङ्कार्यं जायते नाच संग्रय: । ३७॥ दरदसन्त्रम ।

गश्चकञ्च प्रभावेण मस्वभूयं खभावतः।

Cf. Rasárnava, Benares MS. V. 37—38.

<sup>†</sup> Cf. Sans, Texts, Vol. I. p. 12. R. R. S. Bk. ii, 103-104.

ततः स्थातं महासत्त्वं रसेन्द्रस्य समं ततः ॥ ३८ ॥ श्रभ्यकादिसत्त्वपातनविधिः ।

एक एव महाद्रावो पार्व्वतीनायमश्चवः । किं पुनस्त्रिभिः संयुक्ता वितसास्त्रास्त्रकास्त्रिकैः ॥५०॥ मुष्काफसानि सप्ताचं वितसास्त्रेन भावयेत् । पुटपाके ततस्त्र्णे द्रवतं सन्तिसं यया । कुक्ते योगराजोयं रक्षानां द्रावणे प्रस् ॥ ५१॥

यभ्यकादिद्रतपातनविधि:।

तालीन वङ्गं दरदेद तीच्यां नागेन चेन्नं शिलया च नागम्। गन्धासमना चेव निचन्ति शुक्तं तारच माजीकरसेन चन्धात्॥ ५२॥

गुल्बम् प्रजाचीरसुगन्धकेन तारं सुष्ठीचीरसमाचिकेण । यद्यस्य धातोविष्ठितस्य युक्तं निरुष्णघातं कथितस्य तोस्पैः । ५४ ॥ स्तानि लोडानि रसीभवन्ति रसेन युक्त्यामयनायनानि । षभ्यासयुक्त्रा पस्तितादिनायं कुर्ळन्ति तेषाच्च जराविनायम् ॥ ५४॥

रित नागार्जुनविरचिते रसरत्नाकरे वजुमारण-सत्त्वपातन-प्रभाकादिद्रावण-वजुलोच-मारणाधिकारो नाम दितीय:।

चवाती रसबन्धाधिकारं व्याख्यास्थामः।

जम्बीरजेन नवसारधनाम्बवगै: चाराणि पञ्च लवणानि कट्स्रयञ्च । शिग्रूदकं सुरभिस्रणकन्द एभिस्-संमर्दितो रसन्तृपश्चरतिष्टलोडान्॥ १॥

चारणजारणविधि: ।

प्रजापारमिता निशीयममये खप्रे प्रसादीकर्त नाम्ना तीर्च्यमुखं रसेन्द्रममलं नागार्जुनप्रोदितम् ॥॥॥

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रसं हेमसमं मद्यं पौठिकागिरिगन्धकम्। दिपदीरजनीरकां मदंगित् टक्क्णान्विताम् ॥३०। नष्टपिष्टस मुष्कस सन्धमूष्यां निधापगत्। तुषाक्षपुष्टं दस्ता यावद्वस्रत्वमागतः ॥३१॥ भस्त्वणात्माधकेन्द्रसु दिव्यदेशमवाष्ट्रयात्॥३२॥

गर्भयन्त्रं प्रवक्षामि पौठिकामस्मकारकम्।
चतुरंगुलदोर्वेण विस्तारेण च त्राङ्ग्लाम्।।६२॥
मूणां तु स्वायीं कत्वा सहदां वर्त्त्वां दुधः।
विग्रमागन्तु लोइस्य भागमेकं तृ गुग्गुलोः। ६३॥
सुग्रन्तां पेषियत्वा तृ तोयं दस्वा पुनः पुनः।
मूणालेपं हदं वहा लोणार्वस्तिका दुधः॥६४॥
कवं तुषाग्निना भूमौ सदुखेदेन खेदयेत्॥६५॥
सतकस्य पलं रहत्तं तृथायं साङ्गुलं विषम्।
तत्समं गम्यकं शस्त्रं चृणे कत्वा विनिचिपेत्॥८४॥
कत्वा कळासिकामादौ पलं दस्वा च गम्यकम्।
हतपक्षस्य तश्चणे पचेदायसभाजने॥८५॥

<sup>\*</sup> Cf. Rasárnava. Vide Sans. Texts, Vol. 1 p. 4.

यावद्दवत्वमायाति तत्वणात् तं विनिश्चिपेत्। पुटे वा कदनोपत्ने मिद्यं पर्पाटकारसम् ॥८६॥ हितीयपर्पटीरसः।

प्रनिपत्य सब्बेबुडान्

(मद्बोधान्) सकलदोषनिर्मृतान् : वच्चे सर्व्वेहितार्थं

कचापुटं सव्वसितिकरम् ॥

श्रीग्रैलपव्यंतस्थायी सित्ती नागार्जनो सहान् ।
सव्यंसस्वोपकारी च सर्व्यंसाम्यसमन्वतः ॥
प्रार्थितो ददते श्रीष्रं यस पश्चित यादृशम् ।
दृष्टा त्यागस्त भीगस्त स्तकस्य प्रसादतः ।
सर्व्यकस्वानयावधी स्वरसन तवैव च ॥
तिषां सध्ये प्रधानस्च रत्नधोषः प्रचारकः ।
स्ततास्त्रालपुटो भूत्वा नागार्जु नपुरः स्थितः ।
पृच्छते रसकस्याणि विद्यादानं ददस्य मे ॥

योगार्गार्जन उवाच-

साधु साधु महाप्राज्ञ तुष्टोऽहं भक्तवत्सनः। कथयामि न सन्देहस्तत्त्वया परिष्टच्छाताम्॥ वलीपलितनामञ्जला कालस्य ध्वंसनम्। यया लोहे तथा देहे चमते नाच संगय:॥

सत्त्वानां भोजनार्थाय साधिता वटयचिणी। दादशानि च वर्षाणि महाक्कोशः क्वतो सया।। तत्कालदृष्टद्रव्याणां दिव्या वाणी सया युता। घट्टप्रार्थिता प्रयादृष्टा त्वं भव साम्प्रतम्॥

श्रीवटयचिष्युवाच— ०० ००००० साधु साधु सहासिष्ठा का रूटी

किंचित्रार्थेय में सिंह तत्सव्वें प्रदेशस्य हम्।। श्रीनागाजुंन उवाच—

यदि तुष्टासि में देवि सर्व्वदा भक्तिवलाली। दुर्लभं विषु लोकेषु रसवन्धं ददस्व मे ॥

### गालिवाइन उवाच-

सुवर्णरक्षभाष्डारं कुमारी मदसुन्दरी। निवेदितो सयाका में बादेशो देवि दीयताम्॥ साधु साधु सन्दापात्र समादेशप्रपालक। साध्यासि न सन्देही युषाक्षत्वेन साधकम्॥ पुनरन्धं प्रवद्धामि माष्ड्रव्येन यया स्नतम् । रसोपरसयोगेन सिदं स्तं सुसाधितम् ॥ विद्याल्यायनं नागं यद्यार्थंकाञ्चनं स्नतम् ।

यास्त्रं विशिष्ठमाण्डव्यं गुरुपार्श्वे यथा युतम्।
तद्दं सम्मवद्यामि साधनद्य यथाविधि ॥
सद्दायशोभनाः पाचा निरालका दृद्वताः।
कुलीनाः पापदीनास साधयन्ति जिर्तिन्द्रयाः॥
कोष्ठिका वक्रनालस्य गोमयं सार्रामन्त्रनम्।
धमनं लोद्दपत्राणि सीषधं काष्ट्रिकं विद्रम्॥
कन्दराणि विचित्राणि ॥

सर्व्यमलयनं कल्याततः कर्मासमारभेत्॥ रक्षघोष च्याच—

साधियत्वा प्रयक्षेन कोटिवेधी महारसः। ग्रहोरेण विनेतेन सर्व्यं भवति निष्फलम्॥ नागार्ज्यं न उवाच —

कवयामि न सन्देष्ठः साकाण्डेन यथा जतम् ॥ षाद्रैत्वस्य घनत्वस्य चापस्यं गुरुतेजसः। यस्यैतानि न हस्त्रम्ते तं विद्याष्ट्रक्त्त्वम् ॥ नानावणं भवित्स्तं विद्याय घनचापसम् । सच्चणं हस्त्रते यस्त्र सूच्छितं तं वदन्ति हि ॥ गुरुत्वमरुणत्वं वा तेजो भास्त्रसम्बद्धमम् ॥ चन्त्रमध्ये यदा तिहेत् खोटवस्यस्य सच्चम् ॥\*

प्रधातो रसेन्द्रमञ्जलानि यन्त्रविधिः।

प्रिलायन्त्रं, पाषाणयन्त्रं, भूधरयन्त्रं, वंशयन्त्रं, निलायन्त्रं, गजदन्तयन्त्रं, दोलायन्त्रं, भ्रष:पातन-यन्त्रं, भ्रव:पातनयन्त्रं, पातनयन्त्रं, नियामकयन्त्रं, गमन(?)यन्त्रं, तुलायन्त्रं, कच्छपयन्त्रं, चाकीयन्त्रं, वालुकायन्त्रं, भिनसोमयन्त्रं, गन्धकताचिकयन्त्रं, मृद्यायन्त्रं, चिष्ककायन्त्रं, क्रम्(?)भाजनयन्त्रं घोषा-यन्त्रं, गुड्राध्वकयन्त्रं, नारायणयन्त्रं, जालिकायन्त्रं, चारणयन्त्रम् ।

भय प्रवच्चे सुगुरूपदेशान् यः पाटनाच्यस्य रसस्य हषः।

<sup>\*</sup> Cf. Rasárnava. Vide Sans. Text, Vol. I. pp. 17-18.

यसा प्रभावात् चयमे इत्रच्छ-ज्वरादिकुष्ठामयनिग्रष्ठः स्थात् ॥ निचिष्य खन्ने विपुरान्तकस्य वीजं दिशुदार्दयस्वयमाणम्। काथेन तस्य विपुरोद्धवेन समार्दयेल ब्रिटिनानि यावत् ।। कन्धारसेन विदिनं ततस नप्तार्चिषा चाय दिनत्रयञ्च । चूर्णे सिकाया रजनीरजेन समादितं तम् उषतीयधीतम् ॥ बीणि प्रमाणान्यय सप्तमञ्ज सम्पातयेत् पातनयन्त्रयोगात्। सम्पातितो निर्मानतासुपैति मर्व्वपयोज्योऽपि हितं प्रयस्तम् ॥ वर्ल समादाय रसस्य तस्य ग्रुल्बस्य ग्रुडस्य च कर्षमेकम्।

<sup>\*</sup> The text seems to be incorrect,

क्रत्वाष्ट्रपिष्टी विधिवसंयीय गन्धात्रमचूर्वे हिगुवज्ञ देयम् ॥ ष्टतप्रयोगेण विपाच्य पद्मान्-निचिय्य खन्ने परिमद्दितश्व। निष्कच मार्ता लम्तस दस्वा गुष्तापमाषा गुटिका च कार्या। यीलोकनायस्य विभोः प्रसादात् जातं मया पोटलिकाविधानम् ।

इति रसेन्द्रसङ्गलं समाप्तम्।

# Extracts from RASAHRIDAYA.

## भगवदुगोविन्दपादविरचितात

रसद्दयादुडुताः श्लोकाः।

A = MS. from Nepal.

B=MS. from India Office Library, with a commentary, named "Bálánvayabodhiká."

C=MS, from Benares, TUJO

हितीयपटलादुबृताः श्रोकाः।
[टीका—मूर्च्छितरसस्य उत्थापनसंस्कारमाइ—]
पमुना विरेचनेन हि सुविश्वहो नागवक्रपरिमुतः।
स्तः' पातनयन्वे समुख्यितः' काष्ट्रिके काथात्।
[टीका—प्रथ मृर्ज्छितरसस्य पञ्चमोहिष्टपातनसंस्कारं

## स्रष्टयबाह—]

<sup>(1)</sup> A reads पास, which makes the sentence incomplete and the metre defective.

<sup>(2)</sup> A reads ufaud, which is a tautology as well as a grammatical error.

<sup>(3)</sup> কাছিকৰ জাতাৰ is the variant in B. This is a defective metre.

कत्वा तु श्रुव्विष्टीं निपात्वते नामवङ्गगङ्गातः । तिसान् दोवान् मृङ्गाः निपतित श्रदस्या स्तः ॥ घष्टाङ्गुविस्तारं देवेष द्याङ्ग्वं त्वधोभाष्डम् । कष्ठाद्धः समुच्छितचतुरङ्गुवक्तव्यवाधारम् ॥ घन्तः प्रविष्टतव्यतार् देवेदन्जवमम्बन्तिम् खप्रान्ताः । उपरिष्टाचिष्टिपटीं देवोद्द्रषोड्याङ्ग्वविद्यालाः ।

<sup>(1)</sup> A reads सुखिप्टिम,

<sup>(2)</sup> निपालेने नागवद सदीप is the reading in A, which is incorrect as well as defective metre.

<sup>(3)</sup> A reads us quaterant.

<sup>(4)</sup> A reads us, which is a tautology as well as a grammatical error.

<sup>(5)</sup> B reads অহাজুলয় বিলীও, which destroys the metre.

<sup>(6)</sup> B reads दंखंब तु. wherein तु is redundant.

<sup>(7)</sup> B reads सम तशतुरकूल सतज्ञलारा, which mass the metre.

<sup>(</sup>৪) A reads স্বার্থিকয়াজ, which is a defective metre.

<sup>(9)</sup> B reads sin; which is grammatically incorrect.

<sup>(10)</sup> A has enfactfagzgfza, which is senseless.

तस्मित्रधोर्द्वभारके निपातितः सकलदोषनिर्मुक्तः । सुतरां भवति रसेन्द्रो जीर्जयासोऽपि पात्थोऽसी ॥ कत्वाय नष्टपिष्टिं विष्मलाशिखिश्रिषुराजिकापटुभिः । संसेष्य चीर्द्वभारकं दीर्तेषपसेरधः पात्यः ॥ प्रथवा दीपकयन्त्रे निपातितः सकलदोषनिर्मुक्तः ॥ कच्छपयन्त्रान्तर्गतं सम्बयपीठस्वदीपिकासंस्यः । यस्त्रिविषतित स्तः प्रोक्तं तद्दीपिकायन्त्रम् ॥

- (1) A reads afer with w, which is incorrect.
- (2) विपातितसक्ताविष्यंत्र:, an incomplete variant in A.
- (3) A has an incorrect reading—दासजीचंपपालासी.
- (4) This verse and the next two are not found in B.
- (5) A reads रपरेग्य:प्राप्ता, which has no sense.
- (6) A has दीपनयं बे.
- (7) A reads ऋष्ययंत्रे चनागैत, which is grammatically incorrect.
- (8) The word aq is not found in A, thus making the metre defective.

#### सप्तमः पटलः ।

टोका—श्रव विड्विधानमारम्यते—]

यासं न मुश्चित न वाञ्कति तश्च भूयः

कांश्चिद्गुणान्' भजितः नित्यमनुक्तमात्रात्'।

यज्जीर्य्यते प्रचुरकेवलविद्योगात्

तस्मादिङ्गेर्मृनिविङ्गेः सद्य' जारणा स्थात्॥
[टोका—विड्विधानमाद्य—]
सौवर्षक्तकट्कत्रयकाङ्गो'काशीसगन्धकेष विड्नेः।
शिग्नो रस्मतभाव्यस्तास्त्रदलान्यपि हि जारयितः॥
[टोका—विड्निलरमाद्य—]

- A reads কাৰীর্যুবান, which is incorrect. .
- (2) B reads anfa.
- (3) 資本信責所申申申 is the variant in A,
- (4) A reads লুনিয়নীবিদ্ধ, which seems to be incorrect. দ্দিবিদ্ধ : means by seven বিদ্ধs, mentioned below.
  - (5) A reads wife, which is incorrect.
- (6) A has शिवृदसभातभावितम्। मस्य दगास्यपि दि जारवर्ति, which is incorrect as well as defective in metre.

सन्वीष्ट्रस्थम् सम्प्रतिगसितं स्रिम्मूर्वणः ।

गतभाकं विस्तवसयाः तत्वणतो नार्यते हेम ॥

[टीका—चय चारहच गुल्मीवधीराह—]

कदनीपनागतिसः निच्नकनकस्रदानिवासुकैरण्डाः ।

वर्षाभूष्टवमोचक सिहिताः चारा यथानामम् ॥

[टीका—चारविधानमाह—]

पानीय चारहचान् सुसमपनिश्रकाः

वर्षपनागै स्पेतान् ।

कत्वादः खण्डणस्तान् । विपुनतरिश्रमाः

पिष्टपात्रातिग्रष्कान'।

- सब्देश दर्भमृत्य रसः तिप्रतिगतिगतिस्तिम् विष, a variant in A, which has no metre at all.
  - (2) A reads manifacternur, which has no sense.
  - (3) far is not found in B.
  - (4) A reads माचीक, which seems to be incorrect.
  - (5) कुसुनपत्त्रज्ञापत्रक हे व्येतान is an incorrect text in A.
  - (6) A reads ক্লা ন্রাইন্নান, which is incorrect.
  - (7) A has विदुखतर्दाद्यलापृष्ठगानातियुक्तान्.

दन्धं काण्डेस्तिलानां करिसुर्राभश्याश्रोभिरासाव्य वस्त्रैः!
भस्र त्युज्ञा जलं तत्ं सदुर्शिखिनि पचेत्
श्रंसपाकेन भूयः ॥
[टीका—चारजलपाकलच्चमाश्र—]
तच्छ्वमाणं श्रि सवास्यबुद्बुदान्
यदा विधत्ते च्यभङ्गान् बद्धन्।

A reads करिसुरिमस्यीष्टालकानां च सूचे.

तदा चिपेत् चूरवण'हिङ्गमश्रकं चारचयं सञ्जवणानि सुखगर्म' ॥

- (2) A reads a. which is incorrect.
- (3) A reads वावत.
- (4) A reads erroneously यथा वहते.
- (5) A reads चिपेस्नास्त्व. B reads चिपेन्स्वत. Both the readings are incorrect.
- (6) A has चारवितद्यं पट्चवर्ण भूनिस्तर्गं, which mars the metre.

द्रव्याणि संसित्रत्र निहत्य भूतले
व्यवस्थितान्यस्थिकटोरिकापुटें।
संस्थापयेत् सप्तदिनानि धान्यगं
ततः प्रयोज्यं रसजारणादिकम् ॥
[टोका—जारणायां चारविधानमाच्च]
जस्बीरवीजपूरक चाङ्गरीवेतसास्त्रसंयोगात्।
चारा भवन्ति नितरां गर्भद्वनिजारणे ग्रस्ताः॥
[टोका—रसे विड्योजनमाच्च—]
विड्मधरोत्तरमादौ दस्वा सृतस्य चाष्टमांग्रेन ।
कुर्याच्चारणमेवं क्रमक्रमाडकेंग्रेदिन्नम्॥

A reads व्यवस्थितान् सस्तिकठारिकासुले। B reads व्यवस्थितमञ्जलकठीरिकापुटे।

<sup>(2)</sup> A reads बोजपूरक, which is incorrect. The word बोजपूर is not found in B.

<sup>(3)</sup> गर्भपृतिकारचा सन्ता is an incorrect variant in A.

<sup>(4)</sup> A has इला सूत चाएनास्त्र, which is not correct as it destroys the metre as well as the sense.

<sup>(5)</sup> A reads \*\*\*\* which is grammatically incorrect.

#### ऋष्मः पटलः ।

## [टीका—श्रथ रसरागोऽभिधास्त्रते— श्रभ्यकजीर्णस्य क्षायाविश्रेषमाइ—]

जीर्णाभ्यको रसेन्द्रो

दर्शयति "घनानुकस्पिनी" इतायाम् "। इत्रच्यारक्तां पीतां

सितां वधा सङ्गं मित्राम् ।

- (1) A reads जी बांसक, which mars the metre.
- (2) A reads दुरस्यति, which is incorrect.
- (3) ঘলারকন্দিনী ছায়া is the variant in A. ঘলারলঘন্দিনা ছায়া is the variant in B. Both the readings seem to be incorrect.
- (4) জৰ বর্মণীন হিব is the reading in A, which is incorrect.
  - (5) A reads হহা ৰক্ষণিক্ষয়:, which is incorrect.

[टीका—षश्चकयोगाडणंविशेषमाइ—] कृष्णाश्चकेण बनवत् सितरागैर्युज्यते रसेन्द्रस्तु । शेते रत्ते: पीते: वड्डे: खनु वर्णतो ज्ञेयः । [टीका—षय रश्चितरसप्रशंसामाइ—] प्रथ निजमेव हि वर्णे ।

न जहाति यदा स रज्यते' रागै:। क्रमणो डिभच्चमाणों निर्निकों रखनं क्रदते॥

<sup>(</sup>l) वेतासकेन बखवान is the variant in A, which is incorrect.

<sup>(2)</sup> A reads शितराने: पूर्वति.

<sup>(3)</sup> A has কৰিমুলী ইথ, which has no clear sense. B has বহিৰ্ঘুলী ইথ:, which mars the metre.

<sup>(4)</sup> B reads we from with which is not correct.

<sup>(5)</sup> A reads ব্যা ব্যসীজন, which is grammatically incorrect.

<sup>(6)</sup> A reads अञ्चलाचा, which is incorrect. B reads क्रमधी वचलाची, which is also incorrect.

<sup>(7)</sup> A reads नारकी.

[टोका—चभ्रसस्वादोनां योगे रसे व्यवस्वामाह—]
वलमास्तेभ्रकसस्वे जारणरागाः प्रतिष्ठितास्तीस्तोः ।
वन्धय सारलोहें सारणमयं नागवङ्गाभ्याम् ॥
[टोका—सब्बंकरणं तीस्त्रामाह—]
क्रामित तीस्तोन रसः तीस्त्रोनं जीर्थते स्ववाद्गासः है
हेस्रो योनिस्तीस्तं रागान् ग्रह्माति तीस्त्रोन ॥
[टीका—तीस्त्राहिङ्गलयोगेन गुणाधिस्त्रमाह—]
तदिष च दरदेन इतं हला मास्रोकेण रविसहितम् ।
वासितमणि वासनया धनवसार्यस्य जार्थस्य ॥

- (i) A reads erroneously ম্বিছিবা নীক্ষা-
- (2) A reads सार्वश्र; which is incorrect.
- (3) A reads minung.
- (4) B reads नामक्सत:,
- (5) A reads মীজী খ.
- (6) A reads which is incorrect
- (7) A reads की तिसीचे, which has a defective metre
- (৪) B has omitted ছলা দাবীক্ষ ধৰি.

[टौका—तीत्रावदेवानाइ—]
कान्तं वा तीत्रां वा काङ्गीं वा वजुमस्थक वापिं।
एकतमं सब्वं वा रसरजने सङ्करोऽभीद्धः ॥
[टौका—स्त्रं स्त्रं विकार वन्त्रमाणमाइ—]
कुटिने वनमप्यधिकं रागस्तीत्रां तु पद्मगे स्नेहः ।
रागसेहवनानि तु कमने शंसन्ति धातुविदः ॥
सर्वेरिभर्नोहिमालिकसहितेर्मृतिस्त्रधा गर्भे।
विद्योगेन तु जीणी रसराजो विश्वति लोहेषु ॥
[टौका—रसवन्धानां मारणे विधानमाइ—]
तालक दरदिशिलाभिः स्नेहन्तारान्त्रस्ववणसहिताभः।

- (1) काची वा दल्यसकादीनां, a variant in B.
- (2) रसीप कि रसायने विद्यात, a variant in A.
- (3) This is not found in B.
- (4) A reads erroneously quades.
- (5) A reads भानुविध, which is incorrect.
- (6) This sloka is not found in B.
- (7) A reads area.

समकित्युणिविशुणान् पुटो वहेदङ्ग्यस्त्रादीन् ।
[टौका—पुटितधातुक्तत्यमाह—]
रक्तस्वेहनिषेकै: सेकं कुर्याद्रसस्य पिष्टिरियम् ।
चारणजारणमात्रात् कुरुते रसमिन्द्रगोपिनभम् ।
[टौका—सुख्यत्वेन तास्त्रप्रसनमाह—]
प्रथवा केवलममलं कमलं दरदेन वापितं कुरुते ।
विशुणं जीणे जीणे लाजारसस्त्रिभं स्तम् ।
[टौका—विध्यन्तरमाह—]
रक्तमणगिलतपग्रजल-

वद्यु"भावितताय्यगन्धकिशित्तानाम्'।

কিবাছইংক: মজাহীৰ, a variant in A, which has a defective metre.

<sup>(2)</sup> B reads no.

<sup>(3)</sup> A reads afec, which is incorrect.

<sup>(4)</sup> B reads erroneously www.

<sup>(5)</sup> विमुच दि चीचंजीचे, a variant in B.

<sup>(6)</sup> The word \*\* is omitted in B, which renders the metre defective.

<sup>(7)</sup> A reads गम्बद्धिलाभि:.

#### एकेन वापितसृतं

कमलं रख्नयति रसराजम् ॥ |टौका--रामाधिकारि-गन्धकादीनाइ---] वाद्यो गन्धकरागो<sup>8</sup> विजुलितरागे<sup>8</sup> मन:ग्रिलाताले ।

माञ्चीक'सस्वरसकी दावेती' रखने गस्ती ॥

[टीका—प्रधानयोः ताम्बखर्परयोः क्रत्यमाष्ट—] क्रमहर्षेः रविरमकोः संग्रहो सूकसूषिकाधातः ।

- (1) A reads avage, which seems to be incorrect.
- (2) A reads राजकरात, which is incorrect.
- (3) A reads গ্রেবানা. B reads বিলুলিনবারীয়. Both the readings are grammatically incorrect.
  - (4) B reads which mars the metre.
  - (5) B reads दान्ये fe, which seems to be incorrect;
- (6) A reads क्रमहद्वेरविसेकं: B reads क्रमहत्ती रविरमकी.
  We have adopted the above reading after collating the texts.
- मृत्रिकासृत्रिभात:, a variant in A, which mars the metre. सुक्षमृत्रिकापाती, a variant in B.\*

विगुणं जीयां जीयां हिमाभी जायतं स्तः ।
[टीका—घभकयोगमाइ—]
घयः क्षणाभकचूर्यं पुटितं रक्षं भवेत्तयां प्रकलम् ।
विगुणं जीयां जीयां हिमहितसंनिभः स्तः ॥
[टीका—स्वर्णमारणमाइ—]
विगुणेन मास्तिन तु कनकं च सतं रसतालयुतम् ।
पटसहितं तत् पक्षं हिस्हकया यावदिन्द्रगोपनिभमः ॥

- (1) A reads जोचे जीचे. B reads चीची जीची.
- (2) A reads ছবিইনবিনী নবন, (ছবি বুন). B reads হিন্দবর্গানী ভাষন, which mars the metre.
  - (3) A reads wear, which destroys the metre.
  - (4) A omits तथा.
- (5) A reads জীৰ জীৰ, which seems to be incorrect.
  B reads জীৰা জীৰা.
  - (6) क्रेमधृति(?)संनिभी भवेत् सूत:, a variant in A.
- (7) कनक्ष रसताव्युतं, a variant in A, which is a defective metre. The reading of B, which we have adopted, is also a defective metre. The word चेन् or सान् should be added after the word चुनम्.

[टीका—एतइस्मजीर्थस्तस्य सचणमाइ—]
तचूर्णं स्तवरे विगुणं जीर्णं हि' जीर्णं तु।
दुतहिमनिभः स्तीः रज्यति स्तीष्ठानि सर्व्वाणि ॥
[टीका—सञ्जेषां धातूनां रसानामुक्तरोक्तरविशेषत्वमाइ—]
पवादष्टगुणं सत्त्वं सत्त्वादष्टगुणं दृतिः।
दृतेरष्टगुणं वीजं तस्मादवीजं तु जारयत्।

- (l) A reads জীব বু. B reads খীব ছি.
- (2) স্বভন্তিমন্ত্রী, a variant in A, which seems to be incorrect.
- (3) A has লংকি জীয়ালি হলালি. B has বয়য়ি জীয়ালি য়য়্পায়ি. Both the readings have defective metre.
- (4) This verse is found in A after the verse নাংক इरदक्षिताभि: &c, (vide ante pp 28—29) and runs thus :— पनादचन्य देखा सखादचनुष्य श्रीत । श्रीरचनुष्यं वीत तकादनीत्र त तारयेत ॥

#### नवसः पटलः ।

[ टीका—बीजप्रशंसनमाइ— ]
इति रक्तोषि रसेन्द्रो बीजेन विना न कर्माकद्भवति।
दिविधं तत् पौतसितं । नियुज्यते सिदयेच रसम् ॥
[ टीका—रसोपरसधातूनां बद्दविधत्वात् ग्रोधनमाइ— ]
तस्य विश्वविद्धां गगनरसोपरसलोक्षचू प्य ।
दिविधं बीजं तैरिष नाग्रहे: ग्रध्यते कदाचिद्षि ॥
[ टीका—चग्रहबीजप्रभावमाइ— ]
य: पुनरेते: कुद्दते जम्माग्रह भेविद्रसस्तस्य ।

<sup>(1)</sup> B reads पीतं दितं which destroys the metre.

<sup>(2)</sup> नियुष्ये विद्योग रहः, an incorrect variant in A. नियुक्षते विद्यमेग तत्, a variant in B. Both texts are collated in our adopted reading.

<sup>(3)</sup> বন্ধনি ছবিশাখা, a variant in A, wherein the first term seems to be incorrect.

<sup>(4)</sup> B reads नैतत् instead of कदाचिद्धि. This is incorrect; since it contains two negatives.

श्रव्यापकः पतङ्गो' न रसे न रसायने योग्यः ॥
| टीका—रसमंत्रकानाह — ]
वैक्रान्तकान्त'सस्यकमान्तिक 'विमलादिदरदरसकाश्च'।
श्रष्टी रसास्त्रथेषां सन्त्वानि ' रसायनानि स्यः ॥
[ टोका—उपरसमंत्रकानाह — ]
गन्धकगैरिकसृश्चिला 'चितिखेचरमञ्जनश्च
कङ्ग्रम् ।
उपरससंत्रमिदं'स्थात् शिखिशश्चिनी सारलोहास्थी ॥

- (1) इञ्चादक्षपरंगि, a variant in A, which is incorrect.
- (2) A reads ফাজ B reads হয়াবদ্যই হাল; Both the readings are incorrect.
  - (3) A omits wiff,
  - (4) A reads माचीक, which mars the metre.
  - (5) A reads दलदरमकेय-
  - (6) A reads चलारि, which is not accurate.
  - (7) B reads factors, which destroys the metre.
  - (8) B reads ব্যক্তিব, which mars the metre.

[टोका—पूर्तसंत्रके याह—]
तास्त्रारतोच्छकात्तास्त्रवजुकोहानि नगवङ्गी च ।
कथिती च पूर्तसंत्री तेषां संगोधनं कार्य्यम् ।
[टोका—लवणचारसंत्रे घाह—]
सोवर्चलसेन्धवकं चृत्तिकसामुद्ररोमकविड़ानि ।
षड्लवणान्धेतानि तु सर्जीयवटङ्गणाः चाराः ॥ 
[टोका—ग्रोधकद्रावकगणमाह—]
सूर्यावर्त्तः कदली कन्या कोगातकी च सरदाली ।
ग्रीयुवं वजुकन्दो नीरकणा काचमाची च ॥
ग्रामामकरसेन तु लवणचारास्त्रनाविता वहुगः ।
ग्रह्मात्त्र रसोपरसा भाता सुवन्ति सन्वानि ॥

<sup>(1)</sup> B reads सत्तकोदानि.

<sup>(2)</sup> B reads बङ्गनागी च.

<sup>(3)</sup> B reads कविनी कुन्नसंत्री, which is incorrect.

<sup>(4)</sup> This verse is not found in A.

<sup>(5)</sup> A reads quique.

<sup>(6)</sup> B reads 4221.

<sup>(7)</sup> A reads গ্ৰিয়খ.

<sup>(8)</sup> This verse is found in A only.

[ टीका—शोधकद्रावकाणां शोधनद्रावणविधान-माइ— ]
स्तिन' सचारान्तैः' भातं वैक्रान्तकं इटाद्र्वितः ।
तद् द्रुतमानं श्रध्यति कान्तं श्रश्यक्तमावनया ॥
[ टीका—हन्नाइ— ]
सस्यकमि रक्तगणेः' सुभावितं स्रेडरागसंयुक्तम्' ।
श्रध्यति वारैः' सप्तभिरतः परं युज्यते कार्थ्ये' ।
[ टीका—तन्नाइ— ]
चारैः स्रेडरादी प्रवादान्तेन' भावितं विमलम् ।

- (1) A reads स्थाराचे.
- (2) A reads waterfa, which is incorrect.
- (3) A reads तहत्वारे, which is incorrect.
- (4) B reads τηπθ;, which seems to be incorrect.
- (5) भावनत: सेहरागर्शवृक्तं, a variant in A.
- (6) A reads で花:
- (7) স্থানিলন: पर বীকাইন কাতী, a variant in A, which mars the metre. B reads হয়দিবদিন: पर, wherein অদিন: is incorrect as well as a defective metre.
  - (8) B reads पदात उचेन.

ग्रध्यति तथा च रसकं दरदं माचीकमध्येवम्' ।
[ टीका—तास्त्रगोधनमाइ— ]
तनुरविपत्रं लिप्तं लवणचारास्त्ररिवसुक्चीरै: ।
धातं निर्मृष्डीरसिक्तं बहुगो वहेद्द्रवलच्च' ॥
[ टीका—लोहगोधनमाह— ]
ग्रह्मति नागो वङ्गो घोषो रिवणा च वारसुनिसंख्यै: ।
निर्मृष्डीरसिकें स्तक्ष्त्रस्तरल:प्रवापेस ॥
[ टीका—तचाह— ]

- ব্ৰহ্মাবিক্সমুখ নহা হত্তালি, a variant in A, wherein the last two words are superfluous and incorrect.
  - (2) B reads agric value, which has no sense.
- (3) A reads wfw. B reads www. Both the readings destroy the metre.
- (4) A reads ৰছুলা বছহল. B reads বছুলা হবলত্ব-Both the readings are defective.
- (5) घोसी रिवरीधमपि च मुनिसंखें:, a variant in A. B reads रिवण च बारमुनिनि:. Both the readings are incorrect.
  - (6) B reads 传统, which is not correct.

रक्तगणगसितपग्रजसभावितपुटितं च रज्यते तीक्षम्। ग्रह्मति कदसीयिखरसभावितपुटितं विभिन्नोरैः॥ [टीका—सारणमाइ — ] सर्व्वः ग्रह्मति सोदो रज्यति सुरगोपस्विभी वापात्। माचिकसस्त्वे शृद्धं ग्रद्धं वा गत्यकेन इतम्॥

एकादयः पटलः । कागास्त्रिभस्रनिर्मितमृषां कलैवामलकाकारां । दलयोगे घनरन्त्रां टंकपविषगुष्टकतलेवां ॥

<sup>(1)</sup> A reads tnd, which is incorrect.

ছব্রি কহন্দীলাছিবল্লাহিন প্রতির্ক, an incorrect variant in B.

<sup>(3)</sup> A and B read twfe, which is grammatically incorrect.

<sup>(4)</sup> A reads হয়ট. B reads হাটেৰ ম' Both are unintelligible.

<sup>(5)</sup> A reads मुलेन ना गंधवेन इते. B reads सूते.

[ टीका—षय ग्रम्बकारयितुवेयवर्षनमाइ— ]
गौतांग्रवंगसमावहैइयकुलजन्मजनितकुर्नमहिमा ।
अयित श्रीमदनरयः किरातनायो रसाचार्यः ॥
[ टीका—षय चास्य कारयितुर्गुषवर्षनमाइ— ]
यस्य स्वयमवतीर्षा रसविद्या सकलमङ्गलाधाराः ।
परमश्रेयसहेतः श्रेयसि परमिष्ठनः पूर्वम् ।
येन चतुर्वर्षेत्वं क्हादिव्याधादिकव्यसत्वाभम् ।
टिच्चरसा ग्रहीताः धाटिवराहेणेव महाप्रस्य ॥

- (1) see is not found in B.
- (2) स लगति श्रीसदनय, a variant in B.
- (3) C reads सकतमङ्खाचारा.
- (4) Of the latter half C has only qv 現象司:.
- (5) C reads चतुर्ववंद्धं च्छादिखदातवष्यस्त्राभम्, which seems to be incorrect. Cf. Patala I., in which the following verse is given:—किरातगीपादिकतापसाधवनेचराचनुकुमलासयाने। विद्रति नानाविधमेषज्ञानां प्रमाणवर्षाकृतिनामजाती: ।
- (6) इचित्रजुरस एकीला is the incorrect reading in C. [In the case of जिरातनाय रसा: एकीला; i. e. collected रसः—mercury, minerals &c. and दिचय is favorable; and in the case of चादिवराह रसा एकीला i. e. lifted up the earth.]
  - (7) This verse and the next are not found in B.

नष्टगरीरविवर्णा शीनाङ्गाः कुष्ठिनो गुणाद्यस्य ।
श्रीमनवसीमेखरतामापुरिष पुनर्नवेरङ्गः ॥
[ टीका—कर्त्ता स्वनाममञ्चलं स्वयत्राष्ट् — ]
तस्मात् किरातन्द्रपतेः बहुमानमवाष्य रससुकर्मारतः' ।
रसष्ट्रद्याख्यं तन्त्रं विरचितवान् भिद्युगीविन्दः ॥
नम्ना मङ्गलविष्णोः समनोविष्णोः सतेन तन्त्रोयम्' ।
श्रीमोविन्देन कतः तथागतः श्रेयसे भूयात् ॥
श्रष्टाद्यसंस्कारं रसिन्द्रदेवस्य दिख्यतन् दृष्टा ।
निखितमिदं पुष्यतमं रसष्ट्रदयमवाद्यते सकलम् ॥

C reads रशकनीपदेवती हरू , which destroys the metre.

<sup>(2)</sup> C reads ব্যল্পবিশ্বপর্ম, which seems to be incorrect.

 <sup>(3)</sup> C reads विरचितायां भगवद्गीविन्दः, which is incorrect.

<sup>(4)</sup> C has रसाटव्यनाम तन्त्रीयम्, which is incorrect.

<sup>(5)</sup> C has খীলহুলনবহুনীবিন্দল mai, which mars the metre.

<sup>(6)</sup> This verse and the next are not found in B.

## इति श्रीमद्भगवद्गोविन्दविरचितं रसङ्गद्यं समाप्तम् ।<sup>1</sup> श्रभसस्य ।

## संवत् १६०४ समये ज्येष्ठ वदि १३ भौमे जगन्नायभट लेखि॥ श्रीराम जाल संवत् १८८० पौष वदि ३ भौमे।

(1) MS. A ends abruptly with the colophon, which runs thus:— द्यांत श्रीनीविन्दभगवत्पादविद्यिने रसहदये जीवंदसक्रियाधिकार एकविंग्रातितमः पट खः । The author's account of himself is altogether wanting in it. B has "द्यां सक्त्यरमवैद्यञ्जलिकरीठम्बायमायादपपादपप्रशासकलविद्यापारीय श्रीमद्भियगोविन्द्यक्रती रसहदयः समाप्तः। द्यां श्रीमत्कुरखनंग्रपयीधिस्थाकरमिदमदिशास्त्रक्रीचनुर्भुंकविद्यितायां ... ... सक्ते वाक्षान्यवीधिकास्त्रायां रसहदयठीकायां रसवर्गसासक एकीनविंग्रीऽवर्गेषः। द्यां श्रीः"।

# Extracts from KAKACHANDESVARIMATA.

## काकचग्डेखरीमततन्त्रात्

समुबृताः स्रोकाः ।

ॐ नमः सदाधिवाय ।

कैसासिशक्तरासीनसुमा स्ट्रं जगद्गुसम्। कंदनंदीमद्याकाली भृंगचक्कीविनायकी॥१॥ योगिनीनामष्ट तत्र गुद्धादुगुद्धातरं परम्। कपाली कालरात्री च कालचंद्रकलास्विका ॥२॥ कराली कालकर्षी च काकचक्केखरी तथा। एवमादिस्तथा चान्या योगिनीगणगुद्धकी: ॥३॥

<sup>(1)</sup> The text reads কালখনুকন্দিকা, which is incorrect.

<sup>(2)</sup> The text reads 可知明, which is incorrect:

न्त्रयवाद्यस्खेमानै: सानन्दैर्षृष्टचेतसै:।
तवस्यं भैरदं देवं योगिनीगणविष्टितम् ॥ ४ ॥
केचित् स्तुवन्ति संद्रष्टाः केचित्रगयन्ति गुद्धकाः।
केचित्रृत्यन्ति गुद्धा ये केचिद्रवाद्यं न कुर्ळाते ॥ ५ ॥
हृषितं भैरवं देवं पंचवक्कं विक्रोसनम्।
तं हृष्टा भैरवी दृष्टा जगतां विद्योक्षरी ॥ ६ ॥
कताष्त्रचिष्ट्रा भूता कृष्णतारक्कोचना।
काकचण्डेखरी देवी खबाचेदं तु भैरवी ॥ ७ ॥

## काकचण्डेश्वरी उवाच।

भगवन् देवदेवेश सर्वन्न सर्वविच्छिव'।
सर्वन्नानप्रकाशाय यहं प्रच्छामि शंकर ॥ ८ ॥
कयं कायस्थितो जीवो जीवकोऽसी प्रकीर्त्ततः।
कायस्थः कर्मणा केन स्थितः संसारपंजरे ॥ ८ ॥
जराव्याधिदारिद्रेण यस्तः संसारवंधनैः।
एको व्रजति यानेन एकः स्कंधे वर्षेच तम् ॥ १०॥

<sup>(1)</sup> The text reads www, which is not correct.

<sup>(2)</sup> The text reads usfur, which is not correct.

जयजयग्रद्धं मांगल्यमेकस्थाने च जंतवः । किं कुर्वाणाः प्रकुर्वाणाः कस्मान्ये बृद्धि गंकर ॥ ११ ॥

## श्रीसर्वन्न उवाच।

ख्या त्वं काकचामुंडे साधकानां हितं पिये।
गुद्धाद्गुद्धतरं वाकां पृष्टोहं तु वरानने॥ १२॥
कथयामि समासेन ख्यु त्वं काकचंडिके।
यस्यायंस्य परो नित्यः सनादिनिधनेखरः। १३॥
सक्ष्पो निर्मुणः यांतो विख्वव्यापौ परात्यरः।
सनादिकमैसंबंधः कायस्वो भवते तु सः॥ १४॥
जीवे व्याधिभयं कमें सन्नानात् संप्रकीर्त्तितम्।
तस्मात् कमभवात् क्षिष्टः संसारे संसरेतु सः॥ १५॥
करोतिः विविधं कमें संसारे काममोहितः।
द्रव्योपायं न जानाति कामभोगार्थहेतुना॥ १६॥
कायःक्षेयेन मानव्यो द्रव्योपायं करोति सः।
काववाणिज्यसेवायां मेषाविक्रयविक्रये॥ १०॥

<sup>(1)</sup> The text reads काकरें, which is incorrect.

<sup>(2)</sup> The text reads 春村豆, which is not accurate.

<sup>(3)</sup> The text reads काल केमेन, which is not correct.

वहन्ति काष्ठभारां ख्रां ख्रांभारमनेक था।

यानं यवन च्छ्वं चितं करोति करोति सः ॥१८॥
कामासक्तनरः श्रीमान् कुरुते कर्म नैक था।
कुर्वाणाय नराः केचित् कामासक्तार्थं चिन्तकाः ॥१८॥
जायंते मत्यं कोके स्मिन् दारिद्रोप इतचेतसः ।
जायंते नाच संदे हो कुञ्जखं जा नपुंसकाः ॥ २०॥
महासंसार वे धेन विशुणेन सुयं चिताः ।
इट्यां घोरसंघ हचाटिकां तु नयन्ति तत् ॥ २१॥
एतत्ते कियतं भद्रे यस्तं मां परिष्टच्छिसि ।
किमन्यत् प्रच्छिसे भद्रे तथा ते कथया स्यहम् ॥ २२॥
इति काक चंडे खरीमते प्रथमः पटनः ।

#### श्रीकाकचण्डी खवाच।

क्रवयस्य सहादेव कामभोगप्रसाधनः । सर्घः संपद्मते येन सक्केमात् परमेखर । १॥

<sup>(1)</sup> The text reads 電気電道, which is incorrect.

<sup>(2)</sup> The text reads (a) mafe, which is incorrect,

<sup>(3)</sup> The text reads कुद समेननेकथा, which is incorrect.

तदहं श्रोतुमिच्छामि कथयस्य मसादतः । श्राकाशममनं देव खेचरस्तं यथा भवेत् ॥ २ ॥ पादुकाया दत्ते पंचदिव्यस्त्रीकामसाधनम् । रोचनं श्रंजनं चैव धातुवादरसायनम् ॥ ३ ॥ जलूकाबंधमित्याष्टुः रसस्य मारणं कथम् । सारणं रस्नककृत्वं वज्रीभद्रावणं कथम् ॥ ४ ॥ एतत् सर्वं समासेन ब्रुह्मि विद्युरातक ।

## योगेरव खवाच

मृणु त्वं काकचारं है साधकानां हितं प्रिये । ५ ॥
कथयासि समासेन एयक् सिहार्थसाधनम् ।
न द्रव्येण विना सिहिनं भोगाः काम एव च । ६ ।
द्रव्यहीना नरा सत्वं प्रेतकपेण संस्थिताः ।
कटंति मत्वं लोकेसिन् पर्य्युपद्रवकारणम् ॥ ७ ॥

७ ७ ववं (१) तेषां जायतीप स्तम्रुतेः ।
कुलं सीभाग्यकपं च पांडित्वं ज्ञानसंस्थितम् ॥ ८ ॥
द्रव्यहीना न घोभंते प्राणहीना नरा यथा ।
कुस्सितो ज्ञाणहीनोपि केनापि विधराः स्थिताः ॥ ८ ॥

पदांते मर्ल्यं लोकेस्मिन् द्रव्यस्यं मकरध्वजम् । तसात् संसाधयेद्देवि रसेन्द्रं साघकोत्तमः॥ १०॥ त्रयातः संप्रवच्यामि रसेन्द्रसाधनं तव । मारणं जारणादां च द्रव्यसाधनमुत्तमम् ॥ ११ ॥ वन्दंड: सुदंडख लोहदंडस्त्रधैव च। वयो विना घोषध्ये रसस्य मारणे हिता: ॥ १२ ॥ तादि बोध समासेन यथा जानंति साधकाः। वज्दंडस्तु वजी स्थात् सोइदंडं पुटं विड: । १३। सुदंडं ब्रह्मदंडं च समासात कीर्त्तितं तव । याच्येत्तं समासेन साधका च्रष्टमानसः ॥ १४ ॥ तद्रमं रसमंयुत्रां एकीकृत्य तु मर्दयेत्। श्रंधमूषागतं भातं रसं स्त्रियेत तत्त्ववात् ॥ १५ ॥ सइस्रविधी कर्ता च जायते स महारस:। मूवां संलेपयेत् तेन पुराग्टझ सङीवधी: । १६ ॥ अंधयित्वाग्निमध्ये तु रतिबंधः प्रयं विधिः। पयात् पलसङ्खेनं गुल्बस्य ग्राङ्घेट्वुधः । १०। चन्तवगँ इतं शुल्वं चारवगै इतं शुभम्। वजीचीरार्कचीरेण मर्दयित् ग्रतथा नरः । १८।

पुटं दद्यात् समासेन कालिकारहितं भवेत्। मुवागभींदरे चिष्ठा धामयेत् खदिरानले: । १८ ॥ रसेन्द्र: चिप्यते तच तारं संजायते चणात्। चयात: संप्रवच्छामि सृषाबंधं यथा भवेत् ॥२० । स्तिकाः ग्राइयेत् प्राज्ञस्तृषपाषायवर्जिताः । तुवादन्धास्त्रयो बाह्या मदभागासु त्रयस्त्रथा ॥ २१ ॥ एकोक्तय तु संबंधे मूषां तत् कारयेद्बुध:। गोस्तनाकारसहयौमधवामलकं क्रम् ॥ २२ ॥ मुषाबंधमिति स्थातं साधकानां हिताय वै। चयान्यत् संप्रवेश्वामि रसस्य मार्चं यथा । ३३ म ग्राष्ट्रयेत् पूर्वंबद्भूयः घोषधीस्तिस्रः साधकः। मूवां संलेपयेत् तेन धास्य कर्मं समाचरेत्॥ २४॥ रसेन्द्रो स्त्रियते चिप्रं कुरु कर्मे यदिच्छया। वीतोदकेन कामेन हैमकर्माणि वा ऋणु । २५। कारविज्ञोसमयं पाचं तस्योर्डे स्टब्सयं ग्रुभे। चन्योन्यपृष्ठकंत्रमं कारयेत् साधकोत्तमः ॥ २६ ॥ श्रधीयन्त्रेण तं धाम्य श्रायसं तत्र जारयेत्। तप्तक्लोदरे ष्टष्टं जरते नाच संग्रय:॥ २०॥

तद्गुणं चायसं तच हमं चाष्टगुणं ददेत्।
चोरवज्' तथा चारी घट्जारी डदिरयही। (?)
याहियत्वा रसं तेषां भायसं जारयेवर: ॥ २८ ॥
हमं संजायते तच धर्माकामार्थसाधनं।
यहा खत्वोदरे तथे हमं षड्गुणतां भजेत्॥ २८ ॥
पुरा महीषधैर्युक्तं जरते नात्र संग्रय:।
जारिते सारितं द्यात् पुनस्तं जारयेद्यदि ॥ ३० ॥
कारणं मारणं चेव समासात् कोत्तितं मया।
कारणं मारणं चेव समासात् कोत्तितं मया।
किमन्यत् पृच्छसे भद्रे तथा ते कथयास्यहम् ॥ ३२ ॥

इति योकाकचंडेखरीमते दितीयः पटनः।
प्रयान्यं संप्रविद्यामि प्रश्नकस्य ययाक्रमम्॥ २०॥
द्रावणं प्रश्नकस्येव समासेन विधीयते।
चीरकंचुिकचूर्णेन तद्रसेनाभिभावितं॥ २१॥
निर्मुख्डीवजूदण्डं तु तद्रसे भावितं कुरः।
एकेकं सप्तवारेस्तु भावयेत् साधकोत्तमः॥ २२॥
(भावनान्ते) प्रश्नकस्य प्रस्ने चिपेह्नवयं।
व्हत्या सप्तराचं तु चिपेदश्चं नरोत्तमः॥ २३॥

तेन कस्केन प्रवाणि लेपयेटभ्रकस्य च। कांस्यपार्वेण \* \* \* स्तारे साधकोत्तम: ॥ २४ ॥ सूर्यधास्त्रि तती धायाः सप्तारं साधकोत्तमः । दवते नाच संदेष्ठ: प्रियं दृष्टा यथा स्तिय: ॥ २५ ॥ रसस्य भागमेकं तु द्रतभागसमं कुरु । एकोक्तत्व तुतडाम्यं मृियते नाव संशयः । २६ ॥ नचांशविधकोऽसी चि जायते नाव संशय:। श्रवान्धं संप्रवस्थामि यथा संजायते द्रति: ॥ २० ॥ याष्ट्रयेदभक्तं प्राञ्जः पीतं वा क्रम्णमेव वा। पुरा मंस्कारयुक्तं तुकत्तव्यं साधकेन तु॥ ३८॥ यवासा चित्रकं धारः कंचुकीवजुदंडयोः। वज्वांदाकं चीरं च भवातं टंकणं तथा । २८ ॥ चारत्रयसमायुक्तं पट्पंचसमन्वितं । एकोक्तस्य तुकस्केन अभ्यपत्राणि लेपयेत् ॥ ३०॥ मुषागभादरे चिष्ठा धामयेत खदिरानलै:। दवते नाव संटेडो इति काकचंडेखरीसते षष्ठः पटनः।

## Extracts from RASENDRACHUDAMANI.

सोमदेवविरचितात् रसेन्द्रच्डामणेः

उद्गृताः स्रोकाः।

क्ष्येण सह संयुक्तं धातं क्ष्येण चेक्रगेत्'। तदा निक्त्यमित्युक्तं लोडं तदपुनर्भवम् ॥ एवं कृष्यं सनागं चेत् धातं तास्त्रे लगेत्रहि ॥

निष्कमात्रे तु नागेऽस्मिन् लोहखायां द्वतं सित । स्तो लचगुणां हैभी यलाकां यसित भुवम् ॥ कुसुभातेलतप्तं तत् स्वर्णमुद्रिरितः भुवम् । गुद्धानागोऽयमुहिष्टो वित्तः स्वस्कृत्यभैरवः ॥

The text reads खबु. But रसरवसमुख्य reads लशित्, which seems to be correct.

<sup>(2)</sup> The text reads and High, which is incorrect.

<sup>(3)</sup> The text reads Higenia, which has no sense.

तीच्छं नीचाद्मनोपेतं धातं हि बहुयो हृद्म्।
सदुख्यां दुतद्रावं वरनागं तदुच्यते ॥
सतस्य पुनक्डूतिः संप्रीक्षोत्यापनाख्ययाः ।
दुतद्रव्यस्य निचेपो द्रवे तद्राचनं सतम् ॥
विंग्रत्पचिततं नागं भानुदुग्धेन मिह्तम् ।
विमद्र्य पुटयेत्तावत् यावत् कर्षावयोषितम् ॥
न तत् पुटसक्सेण चयमायाति सर्व्वयाः ।
चपनीऽयं समुद्दिशे वात्तिकौनीगसम्भवः ॥
इत्यं हि चपनः कार्यो वङ्गस्यापि न संग्रयः ।
तत्सष्टहस्तसंस्रष्टः केवनो बध्दते रसः ॥

The text has द्वदावी, which is incorrect. We have adopted the text of रह<वस्त्रवृद्ध.</li>

<sup>(2)</sup> The text reads ভাগীক আবন ভাষ, which seems to be erroneous.

<sup>(3)</sup> The text has অহলাহালি দুওঁহা, which is grammatically incorrect.

<sup>(4)</sup> The text reads mineway, which is incorrect.

<sup>(5)</sup> The text reads হল খীবেল, which is senseless.

स रसो धातुवादेषु शस्त्रते न रसायने ।

श्रयं चि खर्पणाख्येन लोकनायेन कोर्तितः ॥

श्रामकाख्यरजः स्ट्रमं पश्चमां ग्ररसान्तितम् ।

कुमारोम् जतोयेन मईयेदेकवासरम् ॥

चाङ्गेरीस्त्ररसेनापि दिनमेकमनारतम् ।

एवं भूनागधातेन मईयेदिवसदयम् ॥

श्रयेकपलमानेन तावता वपुणापि च ।

दयनिष्करसेन्द्रेण स्ट्रम्णपिष्टी समाचरेत् ॥

योजियत्वाय कल्केन ययापूर्व्वे विमर्दयेत् ।

ततः साररसेन्द्रेण सत्त्वेन रसकस्य च ।

पिष्टी क्रत्या तु पूर्व्वेण पूर्व्वकल्केन योजयेत् ॥

श्रय प्रचाल्य कोण्येन काष्क्रिकेन प्रशेषयेत् ।

<sup>(1)</sup> The text has रसायनम्.

<sup>(2)</sup> सर्ववास्त्रेन is the reading in रसरवसमुख्य.

<sup>(3)</sup> The text reads दिनमेखनगरसम्, which has no clear sense.

<sup>(4)</sup> The text reads सीहन, which is unintelligible.

पलाहँगुहसस्येन स्ट्रगुद्धारसेन च। विसह्य काञ्चिके कुर्यात् सरिचप्रसितां गुटौम् ॥ निरुध्य वज्मूषायां सन्धिवन्धं विधाय च। शुविरे नेवभिः सम्यग्भस्य।भ्यां च धमेत् खुल ॥ ततो सूषागतं सत्त्वं समादाय समन्ततः। धमेत प्रकटम्षायां वङ्गालेन गुड्ये ॥ दश्रशाणं हि तत्सत्वं भस्रना लवणेन च। सकाष्ट्रिकेन संवैद्य पुरयोगेन गोधयेत्। दिनिष्कप्रसिते तस्मिन् पूर्व्वप्रोज्ञेन भस्मना । प्रशीतिगुषितं नागं भात्वा निर्वोष्ठयेत् खल् । इयता' पूर्वसुतोऽसी जीवते न कथसन। चपलोऽयं समृद्दिष्टो लोकनाथेन ग्रन्थना । भनेनापि रसः शीघुं बध्दते पूर्व्ववत् खलु। कारवज्ञीजटाच्यें देशधा पुटितो हि स:। भवेत्रागविनिर्मात्रो यासं ग्रह्वात्वशेवत: ।

<sup>(1)</sup> The text reads मरिकामिता गुटी, which is incorrect.

<sup>(2)</sup> The text reads fafatifati, which has no sense.

<sup>(3)</sup> The text reads THEI, which is incorrect.

मुखं प्रकटमूषायां भवेच विगुणोत्तरम्। जीर्षयासो रसोद्वोष देशको इकरो भवेत्॥ सोऽयं श्रीसोमदेवेन कथितोऽतीव निषतम्॥ भूभुजङ्ग्यकत्तोयेः प्रचाल्यापद्वतः रजः। कृषावणे हि तत् प्रोक्तं धीतार्खः रसवादिभिः॥

खरूपस्य विनाशेन पिष्टतापादनं हि यत्। विष्ठुद्धिर्वर्जितः' स्तो नष्टपिष्टः स उच्चते ॥ श्रय यन्त्राणि वच्चन्ते रसतन्त्राखनेकगः'। समानोक्य समासेन सोमदेवेन सांप्रतम् ॥

<sup>(1)</sup> The text reads विन्दोत्तरा, which is incorrect.

<sup>(2)</sup> The text reads and, which is not accurate.

<sup>(3)</sup> The text has word which is not accurate.

<sup>(4)</sup> The text reads where, which is not correct.

<sup>(5)</sup> But रसरवसमुख्य reads विद्वादिनिर्वित:.

<sup>(6)</sup> But रसरवसमृदय reads प्रदेवत:.

#### कर्ड्वपातनयन्त्रं हि नन्दिना परिकोत्तितम्॥

कोष्ठि(ष्टि)कायस्त्रमेतिह नन्दिना परिकीर्त्तितम्॥

विस्याद्री हिमपर्व्वते च मलये गोमन्तके श्रीगरी सम्चाद्रावय पारियाचकगिरी किंकिधिनामालये। माहेन्द्रेऽप्यय चाल्पवत्चितिधरे तद्रूपनामाधिकं गोपाभीरकसिहवैद्यमुखतो वैद्यः समावेद्यताम्॥

इति श्रीकरवासभैरवपुरवरपतिश्रीसोसदेवविरचिते रसेन्द्रचूड़ामणी रसस्वस्थाने रसमहिम-निरूपणं नाम प्रथमीऽध्यायः

समाप्तः ।

## Extracts from RASAPRAKASASUDHAKARA.

यशोधरविरचितात् रसप्रकाशसुधाकरात्

उड्डताः श्लोकाः।

विमलस्तवरो हि पलाष्टकं
तदनु धातुधटीपटकां चिकाः।
प्रथमिमाथ चतुःपलभागिकाः
स्फिटिकग्रहपलाष्टसमन्दिताः।
सङ्ग्र जलीन विमद्यं च यामकं
लवणकास्त्रजलीन विमित्रितम्।
प्रदितधातुगणस्य च मूषिकां
कुर रसं विनिवेशय तच द।
प्रमह्कामिधयस्त्रवरेष तं
दिद्ययाममञ्जाचयवद्यिना।
प्रवनिपत्तकफचयकारकं
सकलरोगहरं प्रसं सदा।

गजपतेर्बसवद्यसदो रुणां डिजपतीचणवद्यमप्रदः।

युवतिकामविलासविधायको

भवति स्तवरः सुखदः सदा।

मघनसाररमः किल कान्तिद-

स्विख्लकुष्ठहरः कथितो मया।

द्रति कर्प्रसः॥

उदयभास्तरनामरसो ह्ययं भवति रोगविधान्तकरः स्वयम् । मगधिकामधुना सङ्ग गुष्किका-व्यमितस्य सदा परिसेवितः । निस्ततकामविसासविधायकः स्वविरकोऽपि रतौ तक्षायते ॥ गद्छरो बसदोऽपि छ वर्णदो भवति कमीविपाकजरोगद्या । सकसस्तकशास्त्रविमन्यजो हिजवरेण मया प्रकटोक्ततः ॥

इति उदयभास्कररसः ॥

श्रवेदानीं प्रविद्यासि धातुशोधनसारणम्। श्रमुभूतं सया किञ्चित् किञ्चिच्छास्त्रानुसारतः॥ स्वयां रजतं चेति लोहं श्रवसुदीरयेत्। तास्त्रं चैवाश्मसारञ्च नागवङ्गी तथेव च॥ तीच्णलोहं निगदितं दितयं रसवेदिभिः। समित्रलोहचितयं सीराष्ट्ररीतिवर्णकाः। एतेऽष्टी धातवो श्रोया लोहान्येवं भवन्ति हि॥

यय रसक्तगुणाः।

हिविधी रसकः प्रोत्तः कारवेश्वक-दुद्रः'। सस्त्रपाते परः प्रोत्तः प्रथमसौषधादिषु ॥ स तुः मेहहरसैव पित्तस्रेशविनाशनः। रस्त्रनः पारदस्याय नेवरोगचयापहः॥

The text reads कानी बह्नवहुद्देश, which appears
to be incorrect.

<sup>(2)</sup> The text reads qq, which seems to be incorrect.

<sup>(3)</sup> The second hemistich is wanting in the tert.
We have adopted the reading of Tetaequa.

पारदो रसकसैव देहलोहकरावुभी।
नागार्जुनेन कथिती सिढी येही रसावुभी।
कती येनाग्निसहनी स्तखपरकी श्रभी।
तेन स्वर्णमयी सिहिर्राजिता' च न संगय:॥
रसको द्रावित: सम्यक् निश्चिमी रसपूरके।
निर्मालखमवाप्रोति समवारं निम्निलतः"॥
काश्चिके वाघ तके वा न्टमूबे मेषमूचके।
द्रावितं चालितं सम्यक् खपैरं परिश्चयित।
खपैरं रेचितं ग्रहं स्वापितं नरमूबके।
रश्चयेन्यासमेकं हि तास्त्रं स्वर्णप्रभं वरम्॥

<sup>(1)</sup> The text reads [報稿] 可何相, which is not accurate.

<sup>(2)</sup> The text reads निमिज्ञ तं, which is incorrect.

<sup>(3)</sup> The text has only #2, which mars the metre.

<sup>(4)</sup> ইাবিই জাজিই is the reading of the text, which is evidently an error.

वचाहरिद्राचिफला-ग्रह्मूमै: ससैन्धवै:।
भज्ञातकेष्टङ्गणैय चारेरास्त्रेय महितम्।
पादांग्रसंग्रतेर्मूषां हन्ताकफलसिक्साम्।
निरुध्य ग्रोषियत्वा च सूषामुखोपिर न्यसेत्।
प्रधातं खपर ज्वाला सिता नौला भवेद्यदि।
लोडसंदंग्रके सूषां हत्वा कत्वा द्वाधोमुखीम्।
भूस्यामाठालयेत् सत्त्वं यथानालं न भन्यते।
तदा सौसोपमं सत्त्वं पतत्वेय न संग्रयः।
यनेनेव प्रकारिण वारचयकते सित।
विनि:सरेत् सर्व्यसत्त्वं सिंदंगु(१)गुरुणोदितम्।
यथ सौराष्टीगणाः।

सौराष्ट्रदेशे सन्धाता खनिजा तुवरी मता। या लेपिता खेतवस्त्रे रङ्गबन्धकरी हि सा॥

<sup>(1)</sup> The text reads affird, which seems to be in-

<sup>(2)</sup> रसरवसमुख्य says क्याने. See Chap. II. Verse 161.

<sup>(3)</sup> The text reads which is incorrect.

पुक्तिका खटिका' तहत् हिपकारा प्रशस्ति ।
किश्चित् पीता च सुस्मिश्वा गरदोषिवनाशिनी ॥
क्षेतवर्णा परा साम्ना पुक्तिका लोहमारणी ॥
कषाया मधुरा काङ्गी कटुका विषनाशिनी ।
व्रणन्नी कफहा चैव नेव्रव्यापित्रदोषहा ॥
कर्णद्रोगहरा सा तु पारदे वोजजारणी ।
धान्यास्त्रे तुवरी चिप्ता श्रध्यति चिदिनेन वै ॥
चारैरास्त्रेष स्टिता धाता सत्त्वं विमुश्चति ।
तत् सत्त्वं धातुवादार्थे चौषधे नोपपद्यति ॥

यथ पुटानि लिख्यको । भूम्यां वै खन्धते गत्ते बिहस्तं चतुरस्रकम् । क्रगणेन सहस्रेण पूरयेत्तदनन्तरम् । योषधं धारयेषध्ये तदाच्छाद्य वनीपलै: । सहस्राहेन वे सम्यग्वद्धिं प्रज्वान्येत्ततः ॥ महापुटमिदं प्रोत्तं ब्रम्यकारेण निर्मितम् ॥

द्रति सहापुरम् ॥

रसरबसमुद्रय १८५८ कटकी फुडिका.

एकडस्तप्रमाणं हि चतुरसं च गर्त्तकम् । वनोपनसद्वसेण गर्त्तमध्यं च पूरितम् ॥ मूजिकां चौषधेत्राय पूरितां तां तु मुद्रयेत् । गर्त्तमध्ये निधायाय गरिख्डानि' च निचिपेत् ॥ कर्द्वाम्निं ज्वानयेत् सम्यक् सोऽयं गजपुटो भवेत् ॥ दित गजपुट: ॥

उपनं िष्टकं काणमृत्यलय गरिक्डकम्। कगणोपनसारी च तचरा क्रगणाभिधाः॥ प्ररक्षिमात्रे कुंडे च वाराष्ट्रपुटमुच्चते ॥

इति वाराच्युटः ।

वितस्तिदयमानेन गर्तः चेचतुरस्वनम् कुक्टार्ल्यं पुटं विद्यादीवधानाच साधनम् ।

द्ति कुक्टपुट: ॥

<sup>(1)</sup> रसरवसमुचय reads निरिन्हानि.

<sup>(2)</sup> रक्रवसमुख्य reads दराटी.

<sup>(3)</sup> The text reads অভিনাটৰ ক'ই ৰ বাবাছবুতন্ত্ৰ; which seems to be incorrect.

<sup>(4)</sup> The text reads गते कुळांचतुरसकं, which mars the metre.

क्ष्मणैरष्टभिः सम्यक् कपोतपुटमुच्चते । इति कपोतपुटः ।

तुषैर्वा गोवरैर्वापि रसभस्रप्रसाधनम्। माणिकाद्यमानेन गोवरं पुटसुच्चते॥

इति गोवरपुट: ।

मृद्भाग्छे तु प्रपूर्वेव मध्ये द्रव्यं तु विन्धसेत् । षधस्ताक्रवालयेदग्निं सृद्भाग्छपुटसुष्दते । \_\_\_\_द्दति (सृद्)भाग्छपुट: ।

गर्ने तु बालुकापूर्णे मध्ये द्रव्यं तु विन्यसेत्। उपरिष्टादधस्तास विष्टं कुर्य्यात् प्रयत्नतः। तद्वालुकापुटं सम्यगुच्यते शास्त्रकोविदैः॥

इति बालकापुट: ॥

मूबिकां भूमिमध्ये तु स्थापितां दाङ्गुलादधः । उपरिष्टात् पुटं दद्यात् तत् पुटं भूधराभिधम् ॥ इति भूधरापुटः ॥

<sup>(1)</sup> The text reads इश्ला, which is incorrect.

गोवरैर्वा तुषैर्वापि मात्राकर्षमितै: पुटम् । यत्र तज्ञावकास्यं स्थात्मृदुद्रश्यस्य साधने ॥ इति लावकापुट: ॥

> इति त्रीपग्रनाभस्तुत्रीयगोधरविरचिते रसप्रकाशसुधाकरे दशमीऽध्यायः।

षयातः संप्रवस्तामि धातूनां कौतुकं परम्।
स्नानुभूतं मया किस्तित् सुतं यच्हास्त्रतः खनु ।
तदष्टं कययिष्यामि यत् कत्वा ना सुखी भवेत् ॥
रसकं दरदं ताव्यं गगनं कुनटीसमम्।
रक्तसुद्दीपयोभिष मध्यदिनसप्तकम् ॥
जलयन्त्रेण वै पाच्यं चतुर्वियतियामकम्।
तेन विध्यं दुतं तास्त्रं तारं वा नागमेव वा ॥
सद्द(यत)विधी तु तत्कस्को जायते नात्र संययः ॥
एकभागस्त्रया सुतो वजुवक्तग्रय मर्हितः।
खन्ने विर्निध्याच्य रसे पञ्चभागसमन्त्रते।
वेत्रयस्त्रा च रागिस्त्रा पीतकस्कं प्रकायते ॥

षोड्यांग्रेन दातव्यं द्वते तास्त्रे सुग्रोभने। जायते प्रवरं हिम ग्रुडं वर्णचतुर्देशम्। द्वति हेमक्रिया।

स्वर्णमाचिकं संस्रोद्य कान्त्रिके दिवसवयम्।
चर्मरंग्या(गा)रसेनेव मईयेहिनसप्तकम्।
जलेन धौतं तावच यावडेमिनमं भवेत्॥
दरदं रसदेगीयं गोमूवेणैव स्वेदयेत्।
दोसायन्त्रेऽद्भिः चलारि प्रयाच्छुडतमो भवेत्॥
सनःशिसा पद्मनिमा रक्ता चैव सुगीमना।
स्वेदिता सुनिपुष्पस्य रसेनेव तु दोस्या।
याममईमिता ग्रहा सर्व्वकार्य्येषु योष्ययेत्॥
नवसारस्त्रथा स्तः गोधितोऽन्तिमित स्वति।
समभागानि सर्व्वाणि मईयेत्रिस्वकारसैः।
सातुनुष्ट्ररसेनेव कुमारीस्ररसेन वा।
स्र्यांतपे विमहींऽसी पाचितो जलयन्त्रके।
दिनानि बौणि तीवान्ती कुर्यात्तदवतारयेत्॥

<sup>(1)</sup> The text reads (現代前頃, which is incorrect.

<sup>(2)</sup> af [autia] is grammatically incorrect.

यतां वेधयेत्तारं शुढ हेम प्रजायते। जनभेदी यदान स्वाजात कार्य्याविचारणा। शिलया मारितं नागं कुमार्थ्याः खरसेन तु । पटहादगयोगेन नागभस्र प्रजायते ॥ शतसंख्यानि वै कुर्यात् पुटान्धेवं शरावके । कुमार्थाः स्वरसेनैव भावयहिनसप्तकम् ॥ पूर्वेवत् पुटनं कार्यं यतसंख्यामितं तथा । स्तगन्धशिलादहुसमं चेत्रागभस्मकम् । विंगहनीपनैदेखात् पुटं वाराइसंज्ञकम्। भनेन विधिना सम्यक् मतसंख्यानि दापयेत्। पुटान्येवं क्षते चौषि शतानि हादशाधिकम् ॥ पयाद्दे काचमये कूपे दार्त्रिययामकम्। व।सुकान्निं प्रदयाच खाङ्गशीतं समुद्ररेत् ॥ तलभस्य यष्टीतव्यं वेधयेसारग्रहके । श्रद्देम भवेत्रेन नाम कार्या विचारणा । दृष्टपत्यययोगीऽयं कथितो नाव संगयः ।

## Extracts from RASACHINTAMANI.

## मदनान्तदेवसुरिविरचितात् रसचिन्तामणेः

उडुताः श्लोकाः।

है स्ववं तोरिकां स्तं कासीसं लक्कचद्रवै:। विष्टेष खल्बभाष्डस्थं सर्वञ्चलं दिनवयम्। ७६। इष्डिकायां तदारीप्य काष्ठविष्ट्रविधीयते। दिनवयेऽप्यतिकास्ते भस्य खेततरं भवेत्। ७७॥॥

इति वयोदय भक्तस्तः।

खर्पेशे द्वादशांशः स्थात् शिखिशीवं च तुखकं। षड्गुणं माचिकं नित्रभागं याद्यं मनःशिलां। भागवयमिदं याद्यं शीभनागतककंरैः॥ ३८॥

च:पि नेवसाना सन:किसा is the correct reading as stated in the margin of the text.

<sup>(2)</sup> वयी भागा अपि वाच्छा: श्रीभना गतक करा: is the correct reading as stated in the margin of the text.

गंधकत्रयमेवास्ते काचमाचौरसैभृष्यं। दिनसप्तात्र कर्त्तव्या भावना महेनं क्रमात् ॥ ३८ ॥ त्रधोमुखेन यम्बेण तेन निःसारयेद्बुधः। सत्वं तद्रसकस्याय हृदं कार्यंकरं परं॥ ४० ॥ त्रवन्त्रं तहदं सत्वं निर्धमं क्रमेसाधनं॥ इति रसकसत्वपातनं।

विवारं गन्धकहतं तामुहे महयवयं । सत्वं तालख सासैकं योजयेत् सर्वकासदं । ४३ । घन्त्रवर्षे भवेडेमं तामुगंधकमारतं । एतयोदीयते रस्यं जायते कांचनं ग्रमं ॥ ४४ ॥

> इति श्रीमदनांतदेवविरचिते रसचिंतामणी हेमीकरणप्रयोगः ॥

पारदं सीसकं गंधं कुनटी तचतुष्टयं।॥ बीजपूरांभसा पिष्ट्रा बाढ़ं दिनचतुष्टयं॥१०८॥ षय सूच्याणि पचाणि तेन तारस्य सैपयेत्। बीजपूररसेनैतत् त्यृतिमात्राग्नितापितं।१०८॥ एकाधिका भवंत्यव्र भावनासास्य विंगति । विग्रोचावर्त्तितं तारं भवेत्तारस्य कांचनं ॥ ११० ॥ इति चिंतामणी हमीकरणप्रयोगः ॥

हेमभागद्दयं तारं तथा ताम्बं चतुष्टयं। एकतः क्रियते पत्रमतिस्कां निरामयं॥ १११॥ जंबीरनीरसंपिष्टं खर्परस्थाष्टटंकणं। तेन ताम्बय पत्राणि लेपनीयानि वै बहु॥ ११२॥ स्रावन्तेते पुनर्दस्वा मूखके गलितानि च। तदा तानि भवंत्वत्र हेमस्पाणि नान्यथा॥ ११३॥ इति हेमीकरणप्रयोगः॥

एकभागो भवेदारः तारं भागइयं भवेत्। वेदभागं भवेत्तीच्यं सत्वं सत्वाच वे दय। वंगभागं भवेत्यत्वं सर्वमेकत्र कारयेत्॥ १०८॥ टंकपोन पुनः भातं पत्रं कृत्वास्य वक्तुगं। वेसात्रयमिदं भातं तक्तमध्ये निवेधयेत्॥ ११०॥ एवं तारं भवेत्रुनं परीचाचममापये॥ इति तारोत्यादकं॥ तुत्यकं पिष्यते खन्ने त्रिफलाहिंगुटंकणै:। सध्वाच्यसित्रितं धातं सत्वं पातयते भ्रवं॥ ६८॥ इति तृत्यकसत्वपातनं॥

खपैरः खेदात पूर्वे कौलखेन जलेन च।
वटारोइजलेनापि पर्णेचूर्णेन ग्रोभनः । ७५॥
गुड़टंकणसंभित्रख्यिफलाकाष्यमर्दितः ।
सन्मये कूपके कत्वा धाम्यमानो स्थां च सः॥ ७६॥
खेतधूमोद्गमे जाते तत उत्थाप्य कूपकं।
सावधानं करेणेव भूमौ तं चाध धानयेत्॥ ७७॥
पुनस धाम्यते कूपः तथाजातं च तं पुनः।
कूपकं च पुनभूमौ तथा तं नामयेत् पुनः॥ ७८॥
सत्वं खपैरकस्थैतत् नाग्रह्णं पतत्वधः॥ ७८॥
सति खपैरसव्वपातनं॥

## Extracts from RASAKALPA.

## रुद्रयामलान्तर्गतात् रसवाल्पादुवृताः स्रोकाः।

थिवं नत्वा रसाधीशं चिक्ककाचरणं तथा। क्रियते<sup>।</sup> रसकस्पोऽयं रसज्ञानविशारदः<sup>2</sup> ॥ १॥

#### । यथ परीचा ॥

चतेजा चगुरु: ग्रुस्त्री लोइडा(ऽ)चञ्चलो रसः । यदा नावार्स्तयेडक्की नोड्ड गच्छेसदा सृतः ॥ ४०॥

<sup>(1)</sup> The text reads 本行神, which is grammatically incorrect.

<sup>(2)</sup> The reading in the text is विशाददम्, which is incorrect.

<sup>(3)</sup> The text reads ve, which is incorrect.

<sup>(4)</sup> The text reads ब्दामाव संवेत, which is not correct.

#### दन्ते खड्डे मणी वेणी रचयेत् साधितं रसम्। ४२॥ इति खीद्द्रयामचे रससंकेतकं नाम प्रथमोज्ञासः।

हेमरूप्यार्कवङ्गाहि'लौहा लोहाः" वहौरिताः । प्रकृतिमा इमे येषां वर्त्तादाः स्युस्तु अतिमाः ॥१॥

सन्तो वद्याञ्जलिपुटो युषान् विद्यापयाम्यहम्। कपास्रधारसयुता दृष्टिग्रन्ये प्रदीयताम् । महारसाः स्युस्तवादावष्टी पारदहिङ्गुले। वैषावं प्रस्तवं ग्रैलं चपलं रसकोऽमलम् ।

(महारसाः)

<sup>(1)</sup> The text reads wrift; which is grammatically incorrect.

<sup>(2)</sup> বাছিবছি is the reading of the text, which seems to be incorrect.

<sup>(3)</sup> The text reads रेवाचौदासुक्रतिया, which is palpably an error.

चभ्वकं तुत्यकं कान्तं राजावर्त्तमयाञ्चनम्। वजुं वैक्रान्तकं चेव टङ्क्यं च रसा बहु॥

(रसा:)

गन्धकं तालक्षणिले चितिखेचरगैरिकाः। इत्यादयबीपरसाः सर्व्याचार्व्यक्दौरिताः॥

(उपरसाः)

सितासिताद्यं पीतं गन्धकं तचतुर्विधम् ॥ तासकं दिप्रकारं स्थात् गोदन्तः पाटलच्छविः ॥ रक्ता पीता शिसा देधा पूर्व्या येष्ठोत्तराधमा ॥ बहुप्रकारा सीराष्ट्री कासीसं चिविधं मतम् ॥ कासीसं पुष्पकासीसं हीरकासीसमित्यय ॥ गैरिको दिविधः प्रोक्तः सीवर्णां लोहितस्त्या ॥

The text reads "uzengfa, which seems to be incorrect.

<sup>(2)</sup> पूर्व देशोशमाधमा is the reading of the text, which is incorrect.

<sup>(3)</sup> The text reads कासीसिक्षिण सत:, which is in correct as it is mentioned neuter in the next line.

#### कङ्गुष्ठादीन् 'रसान् केचिदाचार्या वर्णयन्ति वै । प्रसाभिरिङ तदोन्नं सुनिमार्गानुसारिभिः ॥

दखेष पोदितो मार्गी रसगोधनकर्माण । खच्छन्दभैरवाद्युको गोविन्दादिसमाहतः ॥

लवणं चूलिकोइतं गन्धकेन समन्तितम्। सर्व्वोङ्गदश्वः चित्रार्द्धं मूलभस्तप्रगालितम् ॥ गोमूचेण गतं भाव्यं तदसे जारयेत् ग्रनीः। तस्य संपर्वतः स्तो राजसो भवति भवम् ॥

The text reads ক'কুছাতীৰ, which is an error of the scribe.

<sup>(2)</sup> The text reads 明明情報; which is incorrect.

<sup>(3)</sup> The text reads wattage, which seems to be incorrect.

<sup>(4)</sup> মৰি:, as given in the text, is grammatically incorrect.

एतदेव विद्धं दखात् सब्बंदा हमजारणे'। मुखं संजायते तेन जोर्य्यते च विनिश्चितम्। इति त्रौरद्रयामचे रसकत्ये उमामहेश्वरसंवादे रमशोधनप्रकारः॥

इति संधानयोगीऽयं जारणेऽतिगुणावहः ॥ प्रकाधितः संप्रदायक्रमपाप्तः श्रिवोदितः ॥ इति श्रीक्ट्रयामले रसकल्पे उमामहैम्बरसंवादे रसाधिकरणो<sup>8</sup> नाम द्वितीयोज्ञासः॥

मद्वारसानां सर्वेषां रसानां ग्रहिर्चते । तथैवोपरसानाञ्च शास्त्रहष्टेन वर्त्वना ॥ १॥

कदनीयचजेनी रै: मात्तीकं भावयेत् यतम् । गन्धवं तैलमध्वाच्य-पक्तमेकं दिनव्रयम्॥

<sup>(1)</sup> The text reads देवजारको, which is not correct.

<sup>(2)</sup> The text reads #, which appears to be an error.

<sup>(3)</sup> The text reads रसाधिकारेचा, which is incorrect.

<sup>(4)</sup> The text roads not which is senseless.

तत्तायं वजुम्मूषायां पकायां निचिपेत्ततः । लोडसन्धानकरणं तत्समं तत्र निष्यचेत् ॥ हढ़ां प्रकल्पयेम्पूषां कोष्ठिके विनिवेशयेत् । श्रङ्गारैः खदिरोङ्गतैः धमेदभस्ताहयेन वे ॥ वक्तनालयुजा सत्त्वं ताष्यस्य पतित भ्रुवम् । ग्रक्तदीप्तः सशब्दवं यदा वैकानरो भवेत् । तदा सत्त्वं तु पतितं जानीयात्रान्यया क्वचित् ।

रसकं स्वेदयेदादी पटुचूर्णक्रतं बुधः। चतुर्गुणेन वस्त्रेण दृढ्ं बध्वा च डोलिकाम्॥

নগগাল হলন্দা is the reading of the text, which
appears to be incorrect.

<sup>(2)</sup> The text sক্ষাইৰ্থা is evidently incorrect.

<sup>(3)</sup> কীতিকালি শিবিস্থীৰ is the reading of the text, which has no meaning at all.

<sup>(4)</sup> The text reads exec, which is 'grammatically incorrect.

<sup>(5)</sup> रसकाददयदादी is the reading of the text, which seems to be incorrect.

कला भाष्डे च सकते' खंदियसासपश्चकम् । उदृत्य पसाद्रसकं खन्नमध्ये विचूर्णयेत् ॥ पादीयान् मालतीजातं सगुड़ं जीर्षगुष्प्रकम् ॥ रहधूमं रेवकीं च नियामं कुक्कजीरकान् ॥ तत् सब्वे चूर्णितं कला गोपंचकविभावितम् । कला तद्विटकाः पद्यात् कायायां योषयेत्ततः ॥ कोष्ठगेनाम्निना' पद्यादमेद्भस्त्रादयानिनेः । सत्वं पतत्यसंदेदं स्थिरदं हदं बहु ॥ एकमासं दिमासं वा रसकं स्वेदितं यदि । न भातव्यं तत्र कोहे भमत्तत् नालसूषया ॥

इति सम्पादितो मार्गी दुतीनां पातने स्फुट: । साचादनुभवैर्द्धे न त्रुतो गुरुदर्धित: ॥

हाला भाखेन सकले is the reading of the text, which is incorrect.

<sup>(2)</sup> The text reads खल्लमधी.

<sup>(3)</sup> The text has with the disconnection of the disconnection.

<sup>(4)</sup> The text reads कोटबनारियना, which is not correct.

लोकानामुपकाराय एतत् सब्बं निवेदितम् । सर्व्यवां चैव लोडानां द्रावणं परिकोक्तितम् । इति यौदद्रयामले रसकल्पे उमामहेखरसंवादे सब्बं लोडद्रातपातनाधिकारः समाप्तः ।

# Extracts from RASARAJALAKSHMI.

विषाुदेवविरचितायाः रसराजनस्मााः

प्रारच:-

यस्येच्छाकुरवक्षरी सुकुलिता नानाकलाकीतुकैः चातुर्व्यकविलोलपक्षववती कीर्त्तिप्रस्नप्रसः।

<sup>(1)</sup> समाप्त प्रथम is the reading of the text, which is not correct.

संनिर्वापयति व्यरव्रयमश्चे च्छायाकलापैर्नृषां सोऽयं पातु विचारमूर्त्तिरखिलं कालापलीट्' अगत् ॥१॥

जयति दुरितसर्पस्तंडमंत्रोद्यदपं:

प्रवसगदविनामः सेविविध्वस्तनामः।

श्चिव इव विज(बीज ?)मंत्र: संदितायोगमंत्र:

विपुरहरतनूजस्तेजसः कायपुंजः । २ ।

रति श्रीपिकतमशादेवतनयश्रीविश्वदेवविरचितायां रसराजसक्तामस्तासः प्रथमः ॥

हद्वेमं रससागरं शिवक्ततं खीकाकचण्डेखरी-तन्त्रं स्तमहोदधिं रससुधाश्वीधिं भवानीमतम्। व्याहिं सुखुतस्त्रमीशद्भद्रयं स्वच्छंदशक्ष्यागमं खीदामीदरवासुदेवभगवदृगीविन्द्रनागार्जनान्॥ प्रथम: उक्रास:।

> स्रच्छंदग्रतागमसारभूतः समुद्रुतो विषाुभिषम्बरेग ॥ ११० ॥ दितीयः उज्जासः ।

#### षात्तीका सञ्चतं इन्द्रशारीतचरकादिकान् । षात्रेयं बाग्मटं सिद्यसारं दामोदरं गुरुम् ॥

खतीय: चन्नास: ।\*

> महारमाः सुमतादावष्टौ पारद्विंगुली । वेषावं समावं ग्रेलं चपलं रसकोमलम् ॥ ५ ॥ षभकं तुक्कं (tutthakam) कार्त राजावर्णम्याज्ञनः । वन्यकेकातकं (o vaikrántakam) चिति टेक्कं च रसान्दिः ॥ ६॥ तालकं नंधकमिले चितिसेचरगैरिकाः । इत्यादययोपरताः पूर्वाचावैददौरिताः ॥ ० ॥

Aufrecht's "Catalogus," p. 321, No. 761.

Colophon at the end of the Rasarájalakshmí— राजन् (सग्र)यार्वरिवल्सराद्यदिवसे वारे श्विमांगोरिदं चंचदृभूतज्ञपत्तने विजयिनि श्रीवृद्धश्रवीपते: । ग्रास्तं वैद्यकसारक्ष्यमकरीत् श्रीविश्युदेतः कविः वाग्देवीचरणारविंदमकरंदामोदसीरस्थेदाक् ॥

## Extracts from RASANAKSHATRAMALIKA

मथनसिंइविरचितायाः रसनचनमालिकायाः

उड्ताः श्लोकाः ।

चतुबतुःशंखकपर्दिकानां सतक्रक्कीरविमर्दितानाम् । षाफेनमाचीकविषदयानां पलं पलं दन्तिफलान्वितानाम् ॥ २५ ॥ यतभस्मगन्धस्ता हितयं वङ्गस्य ग्रहतीस्यस्य ।
दग्ध्वा मृगस्य सृष्टं विगुणं दस्ता रसार्हविषम् ॥ १२१ ॥
चित्रकायोतिश्विवाहषदयम् लदिवनदिवस्त्वगिरैः ।
कल्डसारविकातकैः प्रत्येकं भावनवितयम् ॥१२४॥
दस्ता सुसिद्दमाक्षो मारिचधूपेन धूपितः सम्यक् ।
स्वस्त्रमरवास्यो रसः समस्तामयध्वंसी ॥ १२५ ॥
चिक्रदुकरसेन युक्तो विशेषतः समिपातहरः ।
यहिषगदामयश्चम्यविद्विवातगुस्यज्ञयौ ॥ १२६ ॥
दित स्वस्त्रन्दसैरवो रसः ॥\*

दयं मानविभूपानभिषजा भिषजां मता ॥ जुता मधनसिंडेन रसनचन्नमानिका ॥ १४२ ॥

> दति रसनचयमालिका समाप्ता ॥ स्वस्ति संवत् १५५० पाम्बन क्रणा ५ सोमे ।

<sup>\*</sup> The सक्तिर रस mentioned in the रस्त्रसन सारिका is quite distinct from that, which is stated in the रसेन्द्रिकामधि. Neither has it any analogy with what is described in the रस्त्रसमूच्य.

## Extracts from RASARATNAKAR

## नित्यनाथविरचितात् रसरत्नाकरात्

उद्दृताः श्लोकाः ।

यदुक्तं मभुना पूर्वं रसखण्डे रसाण्वे।
रसस्य वन्दनार्थे च दीपिकारसमङ्गले।
व्याधितानां द्वितार्थाय प्रोक्तं नागार्क्जनेन यत्।
वक्तं चर्पटिसिडेनं स्वर्गवैद्यक्तपालिके।
अनेकरसमास्त्रेषु संहितास्त्रागमेषु च।
यदुक्तं वाभटे तन्त्रे सुश्रुते वैद्यसागरे॥
पन्येय बहुभि: सिडें: यदुक्तच्च विलोक्य तत्।
तत्र यद्यदसाध्यं स्वाद्यद्यद्दुर्क्षभमीषधम्॥
तत्तत् सन्त्रे परित्यञ्य सारभूतं समुद्रुतम्॥
काचिक्तास्त्रे क्रिया नास्ति क्रमसापि न च कचित्।

মুসহিভিত্তন is the reading in the Sanskrit college MS.

मात्रायुक्तिः कचिकास्ति सम्प्रदायो न च कचित्। तेन सिविने तत्रास्ति रसे वाय रसायने । वैद्ये वादे प्रयोगे च तत्साद्यको मया क्रतः । यद्यद्गुक्सुखान्द्रातं स्नानुभूतस्य यद्मया । तत्तकोकवितार्याय प्रकटीक्रियतिऽश्वना ॥ प्रथमोपदेशे ।

दति श्रीपार्व्वतोपुच्चनित्वनाविसद्विरचिते रसरत्नाकरे रसखण्डे रसपौठिका नाम प्रवमोपदेश:।

परीचा मारिते क्ते कर्त्तव्या च यथोदिता।
चाधसुवाम्निना तप्ती द्वाचीयस्तिष्ठते यदा।
तदा भक्त विजानीयामुक्त्यां यामे निरीचयेत्।
द्वतीयोपदेशे।

दम्ले खड्डे श्वाबा वंग्रे रचायेत् साधितं रसम्। चतुर्थीपदेशी।

षयातः ग्र**दस्**तस्य सृष्ट्यंनाविधि**र ज**ते । मेघनादावचा**हिङ्**शूर्खेमं ईयेंद्रसम् । नष्टिपष्टन्तु तद्गोलं चिङ्गुना वेष्टयेद्दिः।
पचेत्रवणयम्बस्यं दिनैकं चण्डविङ्गना ॥
जर्द्दंबम्नं समादाय दृदं वस्त्रेण वस्त्रयेत्।
जर्द्दाधी गन्धकं तुन्धं दस्ता सीमानले पचेत्।
जीर्णे गन्धे पुनर्देयं षड्भिवीरेः समं समम्।
षड्गुणे गन्धके जीर्णे मूर्च्हितो रोगहा भवेत्।
चतुर्थीपदेशे।

## Extracts from DHATURATNAMALA.

#### धातुरत्नमालायाः

पारकः-

प्रणम्य विततीं यितां विस्ट स्यूत्य सिकारिणीं। धातूनां रत्न सालायाम भिधायं करोम्य सं॥१॥ त्र स्वविषाु स्राचान् ये सत्ती ध्यायंति नित्ययः। स्वानदानप्रदानाय सामे विष्टेखरी सता॥२॥ श्रय धातूनां रक्षमालां वद्यामि।
रीम्यं हमं तथा ताम्बं नागं वंगं तथायसं।
खपराभ्यकमीतां च प्रवालं तालकं ग्रिली । ३ ॥
सवर्णमाचिकं सूतं होरकं च ब्रवीम्यहं।
सर्वधातूपधातूनां लच्चणं मारणं गुणं॥ ४ ॥

षय रीप्यमारणं।

रौष्यं ग्रहं समादाय नागेन गुरु शोधयेत्।
ग्रहे तारे पुनः वश्वात् स्ट्यापवाणि कारयेत्॥ ५॥
निविचिणिद्राच्वाभिः शोधयेच एथक् एथक्।
चालयेदुदकेः साईं तथा दुग्धेन शोधयेत्॥ ६॥
गंधपारदयोरेकं किंचिहंगं च वर्षयेत्।
द्राच्वाया द्रवसंयुक्तं तारपचाणि शोधयेत्॥ ७॥
चक्रयन्ते विनिच्चित्य लेपयेद्वस्त्रस्तिकां।
चिपेद्गजपुटे गर्से ज्वालयेद्वस्त्वानकान्॥ ८॥

समाप्ति:-

ग्रंथी वैद्यकनामायं रससिद्वांतसागरात्। धातूनां रत्नमाला च ततो वैद्यस्य हेतवे। १०६॥ सरचेभ्यो भयत्रस्ता रोगग्रस्तास ये नराः।
रत्नमाला कता तेषां वैद्यानां च हिताय वे । १०० ॥
इति स्रोवैद्यकशास्त्रे चित्रानीकुमारसंहितायां
धातुरत्नमालायां समाप्तीऽयं ग्रंथः ॥

The following is taken from Aufrecht's:
"Catalogus"—No. 760.

Incipit:—प्रणम्य सारदां यक्तिं स्टेर्सिलिकारकां। धातूनां रक्षमालां च विवोधाय करोम्यदं

१ ॥ ब्रह्माविष्णुहरान् ध्यायेद्वक्ता ध्यायंति नित्ययः।
तेषां वरप्रदानाम सा सयैवसुदौर्ध्यते। २ ॥ रूप्यं
हेम तथा ताम्तं नागं वंगं तथायसं। खपैरं गगनं
प्रोक्तं प्रवालं तालकं थिला ॥ ३ ॥ साचिकं गंधकं
स्तं होरकं च ब्रवोम्यदं। सवंधातूपधातूनां लचणं
मारणं गणान् ॥ ४ ॥ रूप्यं युदं समानीय नागसूषा नु शोधयेत्। युदे तारे पुनः पद्यात् सूद्यपत्राणि कारयेत्। ५ ॥ निंबुचिंचिणीट्राचामिः शोधनीयं
एथक् प्रथक्। चालयेदुदकः सादं तथा दुखेन
शोधयेत्॥ ६ ॥ गंधकं पारदं रूप्यं किंचिद्वंगं च

घषंयत्। द्राचारसेन संयुक्तं तारपत्नाणि लेपयेत् ॥ ७ ॥ नतं यन्त्रे विनिचिष्य लेपयेद्वस्त्रसस्तिकां। चेष्यं गजपुटे गर्ने ज्वासयेच ग्रहीपसै: ॥ दं॥

In fine libelli disticha haec leguntur : ग्रंथो वैदा [क] नामायं Rasasiddhántaságarát । धातूनां रक्षमासा च सता वैद्यसहतवे ॥ १ ॥ मर्थेभ्यो भयत्रस्ता रीगगस्ताय ये नरा: । रक्षमासा हि धातूनां सता तेषां हिताय वे ॥ २ ॥ Játyá Gurjarakhandas cha, Devadatto

hi dharmavit

Harer námábhidhánasya सुतस्तस्य भिषम्बर: ॥३॥ संहितारसक्तमीणि यस्य वृद्धिगैरीयसी । तेन शास्त्रविधिन्नेन कता रक्षस्य मास्तिका ॥ ४ ॥ इति देवदत्तकतवैद्यकशास्त्रे धातुरक्रमासा ॥

# Extracts from RASAPRADIPA.

रसप्रदीपादुडृताः स्नोकाः ।

A—MS. from Alahabad. B—MS. from Benares.

षय शङ्कद्रावरसः।

स्फटिका नवसारस सुखेता च सुवर्सिका । प्रयक् दयपनोक्सानं गन्धकः पिचुसंसितः ॥ चूर्णयित्वा चिपेद्वास्त्रे सन्दये सद्विनेपिते । तन्मुखं सुद्रयेत् सन्यक् सद्भास्त्रेनापरेण च ॥ सरस्थोदरकेणैव चुक्कां तिथ्यक् च धारयेत् । प्रथः प्रज्वानयेदक्षं इठाद्यावद्रसः स्रवेत् ॥

<sup>(1)</sup> A reads আহিকা, B. reads অহিকা.

<sup>(2)</sup> B reads wear, which is not corret.

<sup>(3)</sup> B reads पिसंसियुत:, which is not correct.

<sup>(4)</sup> দুখি উদিন is the reading in B.

याणेकं सेवयदयद्वात् दन्तस्य श्रेविविक्तितम् । गुल्मोदरयकत् श्लोष्ठमन्त्रियक्मादिशूलनुत् । बलपुष्टिपदी श्लोष भुक्तं च जारयेत् क्षणात् । विलोक्यतां महालोका रसमाष्ठाक्षप्रमङ्गतम् । कपहैकाय लोष्ठानां यस्मिन् क्षिता गलन्ति हि ॥

फिरक्ष्याधिः— गैरिकं रसकपूरम् उपना च प्रवक् प्रवक् । टक्षमाचे विनिष्पिष<sup>3</sup> ताम्बूनीदनजैः रसैः ॥ वयायतुर्देशास्तेषां कर्त्तस्या भिषगुत्तमैः । सार्यं प्रातः समग्रीयात् एकेकां दिनसप्तकम् ॥

<sup>(1)</sup> B reads un.

<sup>(2)</sup> A reads fun.

<sup>(3)</sup> A reads fefr:feq.

<sup>(4)</sup> A reads चतुर्दशैकोवा. B reads चतुर्दशकोवा.

<sup>(5)</sup> B reads भिषगीतमी, which is incorrect.

<sup>(6)</sup> B reads सम्भोगात, which is incorrect.

<sup>(7)</sup> বিসম্পূত্র an incorrect variant in B.

### सप्तता योलिका 'देया भोजनाये निरन्तरम् । फिरङ्क्याधिनाथाय वटिकेयमनुक्तमा । \*

#### (1) गीधुमरीटिका प्रवार्धः.

\* The following is taken from হানবাছিখী of Trimallabhatta, printed in Bombay in the S'aka year 1810.

> यंत्रे समित्रे उमध्यमाच्ये निधाय सुतस्य पत्रानि पंच। बल्पोक यन साम्बटिके सिकानां समैरिकानां तुवरीयुतानाम् ॥ ६० ॥ सर्वेषवार्ग समभागिकार्ग पर्यादकं चीपरिती निदध्यात । बसेन द्या महिबीभरेन पिष्टं रसीनस्य अरावसेकन् ॥ ८१ ॥ समक्रमेशाव निधाय खंडे-राष्ट्राददेन खर्परकेविंसंधि । चुर्वप्रतिप्रोदरमुर्ध्य भार संस्थाया संस्दा हट सुच्छा।स् ॥ ६२ ॥ प्रव्यालयेडक्रिसधः क्रमेय संखाय यंत्रीपरि वस्त्रमाईम् । वहि पद्याहिनष्टकमत तत् साङ्ग्रीतं परिग्टम्न बुद्धाः ॥ ६३ ॥

# चन्द्रोदयास्य रमवर्षने— कार्य खासे फिरङ्गास्य रोगे च परमो दितः। स्य खपायान्तरम्— सुशस्यां कुलक्क्षेवं पारसीक्षयमानिका। भन्नातकफलं चापि पलमानं सुशक् पृथक्॥

तं डीचपुचीपयसा प्रिष्टं
कृत्यां विद्ध्यात्रवसादरं च ।
कर्षप्रमासं प्रदश्यदं च
विद्रं प्रदश्यद्य ग्रीतलागीम् ॥ ६४ ॥
विद्यादय ग्रीतलागीऽथं
वतः पुरायेष गुर्वेन सुकः ॥ ६४ ॥
विद्यादय गुर्वेन सुकः ॥ ६४ ॥
विद्यादय गुर्वेन सुकः ॥ ६४ ॥
विद्यादय गुर्वेन सुकः ॥ ६४ ॥
प्रदश्य करिकेश्वरी सकलकुष्ठकालानलोऽश्विल्ल्यविनाग्रकद्वय ग्राम्ये वृत्तिं वदः ।
सुवर्षसम्बद्धादय प्रताग्रतलाक्यः
समस्वद्यस्तरी रस्पतिः स कर्ष्ट्रकः ॥ ६६ ॥
द्वि कर्ष्ट्रसः भीदस्यं सान् ॥

(1) B reads gagn.

(2) B reads **有理者** 董丰.

पनार्षमानः स्तः स्थात् षट्पनोऽत्र गुड्ः स्वृतः।

एकीकत्याखिनं कुर्य्यात् वटोः कर्षप्रमाणतः॥

खादेदेकां वटीं प्रातर्यावदारोग्यदर्भनम्।

गोदभ्रयानुपानेन फिरङ्गामयनाशिनौः॥

निम्बुकेनः विना नैव वर्जनौयमिद्यापरम्॥

भय उपायान्तरम्—

चोपचीनौभवं चूणं शाणमानं समाचिकम्॥

फिरङ्गव्याधिनाशाय भच्चयेज्ञवणं त्यजेत्॥

<sup>(1)</sup> B reads (कर द्वापविनाधिनी.

<sup>(2)</sup> B reads fran.

# Extracts from DHATUKRIYA or DHATUMANJARI.

## कद्रयामले धातुक्रिया धातुमञ्जरी वा। #

श्रीगणेशाय नमः।

पाव्वस्यवाच ।

चयानम्तरं देवेश ब्रृष्टि धातुसुसंस्कृतिम् । येन विज्ञानसावेण साध्येदातुसंज्ञितः ॥ १ ॥

महादेव उवाच।

धातुस्तुर्थ्यविधः प्रोत्तः तुर्थ्यस्तुर्ये खपचतः (१)³ । सत्त्वं रजस्तमधैव चतुर्थस्तु निरामयः ॥ २ ॥

<sup>\*</sup> The Ulwar MS. (A) reads wingfaun, a part of the Rudrayámala; but the Benares MS. (B) reads wingsuch, a part of the same. The two MSS. are exactly the same in subject matter, differing only in name.

A reads च्यानंतर, which is grammatically incorrect.

<sup>(2)</sup> A reads भानम संस्कृत, which is grossly incorrect.

<sup>(3)</sup> The sense here is not clear,

राजसे राजसी सिहिस्तामसे तामसी सदा। सस्वसाधनं सास्विको घानीते सर्व्वसाधनम् ॥ ३ । पार्व्वत्युवाच।

कथ्यतां देवदेविश सत्तं राजसतामसम्।
भतीव गुणवत् धातोः काय्यं लचणलचितम् ॥ ॥ ॥
उपधातुक्रमेणेव तेषां लचणसाधनम्।
विटकी च सुदा युक्ता तेषां कर्मास् साधनम् ॥ ५ ॥
उपकारी गुणलचं नाना कार्य्यक्रिया श्रमा।
वियोगयोगचाच्च्यं वर्णमेदेलु मारणम् ॥ ६ ॥
समग्रं देवदेविश विशेषा धातुक्तत्क्रियाः।
येन विज्ञानमात्रेण साध्येत् गन्धकीः क्रियाः॥ ०॥

A reads पनीत, which seems to be incorrect.

<sup>(2)</sup> A has 項項系統, which appears to be incorrect.

কাফা লবৰলবিনা, a variant in A, which is not correct.

<sup>(4)</sup> A reads erroneously 在範疇

<sup>(5)</sup> A reads उपकार, which is grammatically incorrect.

#### मशादेव उवाच ।

पृथिष्या गर्भेमध्ये तु धनेका धातुन्तिष्ठति । विस्तृता कियत्कालेन धातुर्भानाविधोदिता ॥८॥ गुणलचण ध्युक्ता धाम्मतं न स्मरामि ६ । कथं ते कथिष्यामि वद ब्रह्माण्डवासिनि ॥ ८॥

पार्वेत्युवाच ।

ये केचित् स्प्रस्थन्त' ईश व्यक्तं कथय साम्प्रतम् । भवतो अनुग्रहेणैव साधनार्थस्य सिध्यति । १०॥

भनेका चातु तिहति, a variant in A, which treats the word चातु in the neuter as well as in the feminine genders.

<sup>(2)</sup> A rends facer, which is not correct.

<sup>(3)</sup> धातुनानाविधीदिता, an incorrect variant in A.

<sup>(4)</sup> A reads egm; which is grammatically incorrect.

<sup>(5)</sup> A reads sixfa v, which is incorrect.

<sup>(6)</sup> कथ्यामास is the incorrect reading in A.

<sup>(7)</sup> A and B read w(ā, which is grammatically incorrect.

<sup>(</sup>S) west is the reading in A and B, which is not correct.

साधनानयं is the incorrect reading in A and B.

#### महादेव उवाच।

शृषु देवि प्रवच्छासि धातुं नानाविधस्त्रितिम्।
गुणलचणसंयुक्तां यथा वृद्धिः कथिष्यति । ११ ॥
सुक्छप्राधान्यताः एते रङ्गलोडकः तास्त्रकः।
रजतेनैयः संयुक्ता धातोकत्तमता सदा ॥ १२ ॥
सध्यमा सत्त्वजा धातुः नीचा च व्रपुसीसयोः।
संयोगे धातुनामा दि नीचा नीचतरा स्पृता ॥ १३ ॥
संयोगन्ते विधा प्रोक्ता उत्तमा सध्यमाधमा।
तास्त्रजासत्वयोयंगिः नारीधातुः प्रजायते ॥ १४ ॥

- (1) A and B read gan
- मुख्यस्थानता is the correct reading. प्राथान्यता is grammatically incorrect.
- (3) A and B have ৰজনীমনাদ্ধী; which mars the metre.
  - (4) A reads ৰজনীৰ, which is not correct.
- (5) Wig: is used here in the feminine gender both by A and B.
  - (6) Vide verse 20.

एषा' मध्योत्तमा प्रोक्ता कार्थ्यकारणयोगके।

चपुताम्बसंयोगेन जाता धातुष्व मध्यमा ॥ १५ ॥
सीसके भद्भदा प्रोक्ता कार्य्यकाले सदोदिता।

घनेनेव प्रकारण येन येन च कर्मस् ॥ १६ ॥
कर्त्य्या जाववो विद्या चात्वा बृद्धिवियारदेः।

घभद्रं सीसके जातं ग्रह उत्पत्यकारकम् ॥ १० ॥

हाटके खेतता जातेः घच्या रजते यदि।

सघुद्रावः ग्रभे शस्त्वे लोहे च द्राविणो कला ॥ १८ ॥

- Both A and B read enq, which is grammatically incorrect.
- (2) संयोगे is the reading in A and B, which mars the metre.
  - (3) A and B reads wins.
  - (4) A reads war, which is incorrect.
  - (5) A and B read mid, which is incorrect.
- (6) A reads चच्चो. B reads चच्चो. Both the readings seem to be incorrect.

जासले पक्षकीना च काठिन्याभ्यधिकी परी।
कला एतास धातूनां जातेभैवति शहता । १८॥
कला एताह शो दिंखाः प्राप्तः सिहस्त जायते।
ग्रस्थजासल संयोगे नारीधातु सु जायते॥ २०॥
कार्यानेक करी प्रोक्ता पात्रामोद सु कोमला।
मारणे जारणे दिख्या चारणे त्रोटने तथा॥ २१॥
निगैन्धा वर्णेरिहता जातिभेद करी स्मृता ।
एतावद् गुणसंयुक्ता कार्योकारण संयुता॥ २२॥

- जाते भवति गृहिता; a variant in A. जाते भवति रगृहिता; an incorrect variant in B.
- (2) A and B read with, which is grammatically incorrect.
- A reads লাগীখনালয়. B reads লাগীখনবেল. Both seem to be incorrect. (Vide verse 14.)
  - (4) B reads पात्रामीदस, which is unintelligible.
  - (5) A reads war.
- (6) Both A and B read vaz, which destroys the metre.

संस्कारे: संस्कृता सळैं: ' सळ्वीसिडिकरी सृता। नानासुवर्णकार्व्येषु रूप्यकार्व्येषु संयुता ॥ २३ ॥ धातुधीता च या धातु: सुधामाय:सुसंस्कृता। कार्व्यसिडिकरी व्येष्ठा च्येष्ठकार्व्यविधायिका ॥ २४ ॥ सळ्व्या ग्र सुधामाय: ' ग्रासग्रहणग्राहक: (१)। ग्राहयेत् ग्रासमात्रेण पाचयेदग्रनं (स्त्रयम् ॥ २५ ॥ स्वकीयाग्रनसंपक्षे जाते भवति सिडिदा। ग्रन्थ्या नेव सिध्यन्ति जायते स्ग-ग्रम्ब्वत् ॥ २६ ॥

A and B want na; thus rendering the foot incomplete.

<sup>(2)</sup> A and B read \$\frac{1}{4}\$, which is not correct.

<sup>(3)</sup> milifefacti is the variant in A and B.

 <sup>(4)</sup> A and B read বিশাহকা, which is grammatically incorrect.

<sup>(5)</sup> A has an incomplete foot सर्वतेश्वया. B also has নুবা तेस्था.

<sup>(6)</sup> A reads पाचरेत মৰ. B reads पाचरेत মৰ. Both of them seem to be incorrect.

<sup>(7)</sup> B reads tign.

तस्मात्तेनैव यक्षेन सुधामायः सुसंस्कृतिः । यथोक्तसंस्कृतियुताः मर्व्वतो धातुकृत्तमाः ॥ २०॥ क्रियोचितसुसंस्कारान् कारयेद्यक्षतः सदा । यथोदितेस्तु संस्कारेयुका कार्य्यकरो सदा ॥ २८॥ सर्व्वत्वत्त्रसंयुक्ता धातुधीता सदैव हि । जायते नैव सन्देष्ठः कार्य्यकारणकारिकाः ॥ २८॥

पार्व्वत्यवाच ।

कियत्परिमिता धातुः संख्या वदत् मे विभो । उत्पक्तिकेचणं तेषां स्थानं चैव पृथक् पृथक् ॥ ३०॥

A reads सुधासाव, B reads ग्रधासाय, Both are unintelligible.

<sup>(2)</sup> Both A and B read signs, which mars the metre.

<sup>(3)</sup> सर्वे ते धानुद्रसमा;, a variant in A and B, which is grammatically incorrect.

<sup>(4)</sup> A and B read only 前頭可, which is incorrect.

<sup>(5)</sup> Both A and B read with; which seems to be incorrect.

<sup>(6)</sup> B reads स्थान' तेवा.

कथ्यतां देवदेवेश सम्मलस्यसंस्कृति:।
भेदोऽभेदोऽध' योगस्य मारणं चारणं तथा॥ ३१॥
पातनं द्रावणं चैव ब्रोटनं जारणं तथा।
सारणं जीवनं पग्दं गोपनं सेपनं पुनः ॥ ३२॥
जातिभेदः सुगन्धस मेसनं जरणं परम्।
समग्रं कथ्यतां देव उपधातुकरी क्रिया॥ ३३॥

महादेक उवाच।

शृणु देवि प्रविष्यामि धातुस्यानानि लचणम्। उपधातुरनेका हिंतिषां मारणचारणम् ॥ ३४ ॥ चचयं राग(१) कारंच शोधनं बन्धनं तथा। मारणादिच यत् प्रोक्षंतत् सब्बं सूयतां ग्रुमे'॥ ३५ ॥

<sup>(1)</sup> भेदाभेदाय is the incorrect reading in A and B.

<sup>(2)</sup> A reads ga;, which is senseless.

<sup>(3)</sup> उपधानुरनेकानि, an incorrect variant in A and B.

<sup>(4)</sup> Both A and B want this word, which may be supposed to be τιπ or τπ here.

<sup>(5)</sup> तत् सर्वे कचवानि ते, a variant in A.

पार्व्वत्यवाच ।

प्रथमं वद देवेग धालनुज्ञमनचणम्। प्रत्येकस्थानकपं हि गुणसम्बन्धकारकम् । १६॥

महादेव खवाच ।

शृण देवि प्रयत्नेन सिवान्तवचनं सम ।

येन विज्ञानसात्रेण जायते धातुकत्किया ॥ ३० ॥

प्रथमे धातुनामानि संखेपात् काय्यं कारणम् ।

काय्यासि च ते भट्टे पयात् स्थानस्य संपदः ॥ ६८ ॥

पादौ सुवर्णनामानि संखेपात् शृण्तां प्रिये ।

स्वर्णं सुवर्णं स्यायं चाटकं विद्वरोचनम् ॥ ३८ ॥

सु(स) रङ्गं च तथा लोइं देवधातुर्मनोहरम् ।

विश्वी विख्वासमं चैव धर्मादं क्षियदेवता ॥ ४० ॥

जोवनम् प्रस्तं चैव हिसे हिमवतोद्ववम् ॥ ११ ॥

देववक्कभगं दिव्यं संसारोत्तारणं महत् ॥ ४१ ॥

<sup>(1)</sup> Both A and B read eqfq, which has no sense.

<sup>(2)</sup> A reads and.

<sup>(3) ₹#</sup> is generally used

<sup>(4)</sup> fungua is the correct term.

जीवनं सर्व्यं लोकानां गरीणां रखनं ग्रभम्।
प्रन्यानि विविधनामानि गोष्यगोष्यतराणि च ॥ ४२ ॥
रजतं च तया रूष्यं चन्द्रथन्द्रस्य दीपकम्।
ग्रभ्य च्योतिःकरं स्वर्णेषद्वीजं तारकं तथा ॥ ४३ ॥
प्रनन्ता वर्त्तते तेषां कथा द्वश्विकराय ये।
स्वापितं लीकिकं चेव येनाग्रत्यसमूहनम् ॥ ४४ ॥
गीतवीर्यं सघुवीर्यं विषष्णं वातनाग्रनम्।
रसपुष्त्रीकरं स्रोदं धातुपुष्त्रनकारकम् ॥ ४५ ॥

- The first term in the previous verse is only কীৰণ.
   But here it is মুখ্যাক্ষীৰণ. Hence there is no repetition.
- (2) चनानि विविधान् नामान्, an incorrect variant in A.and B.
- (3) नीष्यानीष्यतराणि च is the reading in A and B, which has no clear sense.
  - (4) A and B read মুল্লীবিন্ন , which is incorrect.
  - (5) A reads লীজিকা ইৰা, which leaves out খাঁখ.

रतिटं बहुवीयां च ग्रभधाम च संचयम्।
एतानि रजतनामानि ग्रतान्यन्यानि सन्ति वै' ॥४६॥
ताम्त्रं च' त्युम्दकाधिष्ठं ग्रल्वं नागस्य मह्नम्।
नीलं च नीलविश्वमं वमनं चैव पातकम् ॥ ४०॥
उष्णम् उष्णकां सिढं क्षकणं कासमहनम्।
हिमगभं च कामीटं विषदं विषनाग्रनम् ॥ ४८॥
पारक्रम् सहायसं मन्त्रयो मार एव च।
एतानि ग्रल्वनामानि धन्यानि विविधानि च ॥४८॥
जासत्वं च जरातीतं राजतं यग्रदायकम्।
हृष्यभाता वरीयस् बीटकं कोमलं सघु ॥ ५०॥

A has श्रतान्यानि वर्तते. B has श्रतानानि वर्तते, Both the readings are grammatically incorrect.

<sup>(2)</sup> w is dropped in A and B.

 <sup>(3)</sup> The sense of নীলবিদ্দান seems to be নীলবিদান —
 শীলমীদন্ A reads ঘদন', which is incorrect.

<sup>(4)</sup> A reads \*\*\* 4 和 ...

<sup>(5)</sup> A and B read writ w.

चर्माकं खर्परं चैव रसकं रसवर्षकम्'। सदापष्यं बलोपेतं पीतरागं सभस्मकम् ॥ ५१ ॥ एतत्तुं खर्परनाम कार्थ्यकमास सिविदम्'। रसराजार्द्रकं कमी कतं सिविष् जायते ॥ ५२ ॥ वपुस्तापष्ठरं वङ्गं रजतारिष् नीरदम्। भीतवीर्थ्यंकरं सीदं रतिदं तापष्ठारकम् ॥ ५३ ॥

- (1) रहचार्डक, the reading in A and B, is not grammatically correct.
- (2) and is the reading in A and B; which is incorrect.
- (3) Both A and B read কার্যকর্মণু ভিত্তিবান, which is grammatically incorrect.
- (4) বন্ধবাসার্থকাশ কর্মান, an incorrect variant in A
   and B.
- (5) A reads কর ভিত্তির. B reads কর ভিত্তিয়, Both are incorrect.
- (6) Both A and B read τπαιίπ ¬σ, which is senseless here.

मेडमं माडनाद्(?)भूतं सडायं धातुशेषयोः ।
एतानि व्रप्रनामानि सुसिष्ठं कार्थ्यकारकम् ॥५४॥
सीसकं धातुमकं च स्तकं रोचकं परम् ।
रक्तं च रक्तवीर्थं च रक्तवस्तुविवर्धनम् ॥ ५५॥
घन्तक्यं च गस्तीरं धातुमच्चनकारकम् ।
याडकं रसराजेन घचोभ्याचोभणं परम् ॥ ५६॥
विचित्रं विनतं चैव नानारक्षप्रदायकम् ।
नागं नगास्तयं प्रोक्तं सिष्ठकं कष्वशोधनम् ॥ ५०॥
वण्डं वण्डकरं चैव दुरितं वण्डकारकम् ।
एतानि नागनामानि कार्य्यकासे प्रयोजयेत् ॥५८॥
लोचं च घायसं शूरं सूर्यकमीविशारदम् ।
इन्तकं खननं स्वण्यारकं ताटकं मसम् ॥ ५८॥

सुसिदे कार्यकारकान, an incorrect variant in A and B.

<sup>(2)</sup> A and B read श्रीशकां.

<sup>(3)</sup> B has only ৰ বীয় ব, which is incomplete.

<sup>(4)</sup> A reads ख डं ख डकर चेव.

<sup>(5)</sup> A and B read unit, which is incorrect.

<sup>(6)</sup> A has सर्वे प्रारकं. B has सर्वे मारकं

षजरं च जरायुक्तं धात्वाद्यम् पवनीसृतम् ।

कालेयं जीवणं कालं क्षिरं रोगनाशनम् ॥ ६० ॥

यित्रदं सब्बंधातृनाम् प्रचीभ्यं जलविष्ठषु ।

विष्ठदं विष्ठिवीजं च सर्व्वधातुसहायकम् ॥ ६१ ॥

एतानि लोहनामानि जात्वा कर्म्याणि कारयेत् ।

जायते सकला सिहिविधीगयोगसंयुता ॥ ६२ ॥

नामानि धात्संयोगे जातानि तानि च शृषु ।

गुल्वखपँरसंयोगे जायते पित्तलं ग्रुभम् ॥ ६३ ॥

पित्तलं चैव नारीकं कफदं गन्धदुर्ज्वयम् ।

वर्षदं दुर्व्वलं चैव राजतं वक्षमं लघु ॥ ६४ ॥

वक्षतान्त्रसंयोगेन जायते तिन कांस्यकम् ।

कांस्यकं कीमलं चैव नैरसं रसकाठिनम् ॥ ६५ ॥

<sup>(1)</sup> A reads সীয়ই.

<sup>(2)</sup> विश्वीताधीन is the variant in A. विश्वीताधीन is the variant in B. Both the readings seem to be incorrect.

<sup>(3)</sup> সামাণি ৰ ই ছেন, an incomplete variant in A and B.

<sup>(4)</sup> A has जातेन व. B has दावते तेन व.

<sup>(5)</sup> A and B read erroneously ₹fz ₹.

तीव्रनादं सद्दाशब्दम् । उपकास्ति रविषद्दम् । ज्वानापिधानं रीद्रं च ग्राहकं धुम्बरोधनम् ॥ ६६ ॥ एतानि कांस्यनामानि कार्थ्यकाले प्रयोजयेत् । बन्धने धारणे चैव सुद्रणे धूमबन्धने ॥ ६७ ॥ खपैरै: सद्द पारदं दिव्यं किंचित् प्रमेलयेत् । जायते रसको नाम नानारोगहरो भवेत् ॥ ६८ ॥ नामस्तु रहते होनो स्तधातुस्तु जायते भुवम् ॥ ६८ ॥ स एव कोमलास्निस्यः सिन्द्रं जायते भुवम् ॥ ६८ ॥

- A reads মহন্ত্র. B reads মহন্তর. Both the readings are incorrect.
  - (2) A reads আছল, which has no clear sense.
  - (3) And B read van, which is incorrect.
- (4) पारदी दिश्वी is the reading in A and B, which is incorrect.
  - (5) B reads (\$13, which is not correct.
- (6) कीमकाधिन्ये is the reading in A and B, which is not correct.

भनेकाः । साध्येदिया मन्द्रयन्त्रकरीः क्रियाः । पूजनार्थे मम गुणाः सर्व्ये कल्पितरोचनाः । ७०॥ तास्त्रदाहजलेयींगे जायते तृत्यकं ग्रमम् । नाना रसायनी विद्या साध्येत् सा । सदैव हि ॥ ७१॥ रसरसक(१) 'योगेषु राजमर्थ्यादा जायते । राजकं जायते नाम नारी राजकसागतिः ॥ ७२॥ संयोगे साधनं दिखं वियोगे साधनं ग्रमम् । वियोगं पुननेथींगं रसतास्त्रे ग्रुभी विधिः ॥ ७३॥

- A reads एनेका. B reads एनेका. Both are incorrect.
  - (2) A and B read कव्यवरोचन'.
  - (3) It is not found in A and B.
  - (4) A and B read रसारस्योगेषु, which is incomplete.
- (5) সাংবাধানকভাবনি:, a variant in A. সাংক্রেজাবনি:, a variant in B. Both the readings seem to be incorrect.
  - (6) A and B read unfafe:.

श्रनेका साधनी विद्या साध्येह्व्यकाष्ट्रितम्। लभते रसायनी विद्यां खस्योऽपि विक्रतोद्यमी १०४॥ श्रनेनैव प्रकारेण जायते नाम कर्माभः। नामकर्माज्ञताः जाते चित्ते निर्मालताः भवेत् ॥७५॥ एतत्ते कथिता धातोद्यधातोस्तु ताः शृष् । येन विज्ञानमात्रेण कालकास्याः न लिप्यते॥ ७६॥ उपधातोस्तु मध्येषु श्रेष्टा माता रसायनी। तस्या नामानि बद्धामि प्रथात् स्थानगुणानिषः॥ ७०॥

- (1) A reads द्रव्यकीखिन:. B reads द्रव्यकीखित:.
- (2) A and B read नामकनेरदालात, which is unintelligible.
- (3) A and B read fairs, which is not grammatically correct.
  - (4) A and B read & which is incorrect.
- (5) A reads কাৰকাত্ৰ B reads কাৰকাত্ Both the readings are incorrect.
- (6) Both A and B read quife v, which is incorrect.

हरितालं विसङ्गा च रङ्गदीप्तिकरी सदा।
तालं च हरिता हंसी खेतपीतविधायिनी ॥ ७८ ॥
नक्ष्में स्वा प्रिया देशी निमा चैव निमाचरी।
पारदस्य चयकरी पचच्छेदकरी स्नृता ॥ ८८ ॥
रोगहा जीविनी जेबी जरादारिद्रनामिनी।
पतानि तालनामानि संचेपात् कथितानि ते ॥८०।
युक्ती चानेन यः कर्क्षा चच्छोभ्यो जायते सदा।
चनेनेव प्रकारेच कर्क्षा कर्माणि साध्येत्॥ ८१ ॥
सनःशिला भिना यङ्गी कुनटी च क्रतोद्यमा।
दरदा भगिनी देशी सिन्द्रस्य सखी सदा॥ ६२ ॥

<sup>(1)</sup> The 78th and 79th slokas are not found in A.

<sup>(2)</sup> ভ্ৰী বিৰুখানিত, a variant in A and B, which has no sense.

<sup>(3)</sup> बुक्तजानेन दे, an incorrect variant in A and B.

<sup>(4)</sup> A reads च्चीन्यो, which is incorrect.

<sup>(5)</sup> B reads देखा.

पुष्पा पुष्पवती पत्नी यासिनी रसिनी सुषा।

एतत्तु च यिसानाम कार्य्यकासे प्रयोजयेत्॥ ८३॥

यसकं चैव व्योमं च गगनं याद्यकं परम्।

दुष्टवीर्यश्च वातत्व विक्रनादोवताकति । ८४॥

यजरम् यमरं घोरं घोरषस्द्रलं नायनम्।

रसमूलरसातीतं रसन्ने राज्यवर्द्धनम्॥ ८५॥

यसतम् यमरं चैव महास्त्युविनायनम्।

एतान्यस्त्रकनामानि चात्वा कसीपि कारयेत्॥ ८६॥

सोमसं मन्नराजं च विषं वातविनायनम्।

खेतवीर्यं वस्त्यन्य नीसर्यक्ष्यकारकम्॥ ८०॥

खेदनं भेदनं चैव कामवीर्यविवर्यनम्।

वस्त्रनं सर्व्यवित्रनां मारणं पारदे रसे॥ ८८॥

<sup>(1)</sup> A reads gwant.

<sup>(2)</sup> থনৰ ৰ মিলা গানাৰ, an incorrect variant in A and B.

<sup>(3)</sup> Generally used as स्वीम.

<sup>(4)</sup> A reads ৰছিবাই হল: খলি:, which is incorrect.

<sup>(5)</sup> A and B read was, which is incorrect.

<sup>(6)</sup> A repetition of the name.

गगनग्राहके दिन्ने रसयुग्से प्रमेलनम्।

एतानि सम्रनामानि कार्य्यकाले प्रयोजयेत् ॥ ८८ ॥

होनधातोय नामानि संचेपात् तानि च ऋणुं।

येन विज्ञानमात्रेण जायते पारदो क्रिया ॥ ८० ॥

स्क्राा स्क्राफ्लं वारि वारिजं खातिसभ्यवम् ।

श्रक्तिगर्भें च सगरं ऋङ्गारं सङ्ग्लोदयम् ॥ ८९ ॥

तेजसम् अस्तोद्वतं भीतनं भिन्नोमं सनः ।

खयम् वं कलं दीप्तं स्विधि सीभाग्यदायकम् ॥ ८२॥

रितराजग्रहः शोभाकामसन्दीपनं तथा।

स्क्रानामानि रस्याणि जात्वा कम्याणि कारयेत्॥ ८३॥

- (1) A reads at us, which is incorrect.
- (2) B reads मुख्यिं, which is not correct.
- (3) B reads and, which is incorrect,
- (4) B reads ==;, which is not correct.
- (5) स्तीचि सीमान्यदाविन, an incorrect variant in A and B.
  - (6) A and B read a twin, which is incorrect.

विदुमं वरदं वैलावक्षीजातं प्रवालकम्।
नीरसम् प्रधरेसीमा शिखरं शिखरोद्ववम्॥८॥
वर्णदं विवरं चैव ग्रेवियं च विभूषणम्।
विदुमस्थेतकामानि कार्य्यकाले प्रयोजयेत्॥८॥
चर्माकं कूर्माकं चैव कमठप्रष्ठं सकालकम्।
कमठं कर्क्यं चैव कलिङ्गजातः माग्रभम्॥८६॥
कचकं कहर्रः कर्मा लोके कचकठं तथा।
एतानि कूर्माप्रस्य नामानि च विशेषतः॥८॥॥
शक्षं च जलजं चैव देववादित्रमेव च।
विश्ववस्थानं चैव सोमदेवतकं ग्रभम्॥८८॥

- A reads विद्वमें वरदं. B reads विद्वमें वरदे.
- (2) A reads नीरसे.
- (3) A and B read गावेयं.
- (4) A has বিহুমনাবি. B has বিহুমনাবি. Both are incorrect.
  - (5) किन्त्रमध्ये is an incomplete variant in A and B
  - (6) A has mannas;. B has annis;.
  - (7) B reads erroneously विश्ववसभाभकं.

वरायुवं च वरदं ग्रभं माङ्गख्यदायकम्।

श्रेवयं सब्वजन्तूनां दानवास्यि वरोदयम्। ८८॥

गन्धीरं घोषशब्दं च पवित्रं पारदं ग्रष्टम्।

एतानिः श्रंखनामानि वामद्विषकाव्मीः॥१००॥

श्रीतका सीफिकाः कान्ती मुक्तामाता गरीयसी।

चन्द्रपत्नी पयोग्राही संपुटो पटवादिनी॥१०१॥

रजताभासिनी दीप्ता वङ्गवारिविश्रोषणी।

पन्नकरीगितः पन्नगर्भः समुद्रसन्धवा॥१०२॥

उत्तमा मध्यमा नीचा व्रिविधा सागरीङ्गवा।

नद्युङ्गवा तु सा नोचाः नीचकस्यविश्रारदा॥१०३॥

Both A and B read बरं देखे, which destroys both grammar and metre.

<sup>(2)</sup> A and B read एत€, which is grammatically in-

<sup>(3)</sup> A reads वामदिवयदावभी. B reads वामदिवयवात्रभी.

<sup>(4)</sup> B has only शीका.

<sup>(5)</sup> A and B read प्रोगर्भ

<sup>(6)</sup> ন্ত্ৰীয়ৰ ব্য়ীখা, an incomplete variant in Å.
ন্ত্ৰীয়ৰ ব্যীখা, an incorrect and incomplete variant in B.

एतत्तु सचणं ग्रहः' कर्मकासे प्रयोजयेत्'।

प्रात्ता यः कुरुते कर्मा सिडयेत् सकसं फलम् ॥१०४॥

गजोइवं रदं दन्तं द्विजं चैव तु पुष्पकम्।

नारीसीभाग्यदं चैव गजभूषणसम्मृखम् ॥१०५॥

तेसरचाकरं खीदं संपुटं पुटिकं तथा।

नामानि गजदन्तस्य प्रन्यानि मध्यमानि च'॥१०६॥

पिष्क्रकं कुर्वं च व शिखिपिष्कं सुचित्रकम्।

प्रांमीसिधरं खीदं मोइनं चन्द्रकं तथा॥१००॥

नागारिं सर्पदमनं विषदं विषनाग्रनम्।

एतानि शिखिपिष्कस्य नामानि विविधानि च

1 500 1

A and B read থকা অবহা মৃদ্ধি, which is an incorrect variant.

<sup>(2)</sup> वार्मकार्थे प्रयोजने, a variant in A, which seems to be incorrect.

<sup>(3)</sup> A reads att, which is incorrect.

<sup>(4)</sup> चन्छ सध्यतानि च, a variant in A and B, which is grammatically incorrect.

नखं सहदयपुरं धातुकोमलकारणम् । वजुं दुर्गस्थकं चैव तुरीटापस्त चोभकम् ॥१०८॥ कचं केशं च बालं च सूर्वजालकमेव च । स्मामं चैव घनं प्रोत्तां कर्कशं नक्षदं लघु॥ ११०॥ एतानि धातुनामानि यथाकस्तां भिधानकम् । ज्ञात्वा चारस्यते कर्मा स्वस्थे सिद्धिः प्रजायते॥१९१॥ पास्वत्युवाच । यक्षो शक्कर विक्वेश विक्वनाथ जगद्गुरो । स्नुतानि चैव नामानि स्थानानि कथ्यन्तां प्रभो ॥१९२॥

न च्ह्यपुर, a variant in A- न च्ह्यपुर, a variant
 in B. Both are incorrect.

<sup>(2)</sup> B reads wrew.

<sup>(3)</sup> B reads and, which is not correct.

<sup>(4)</sup> A reads तुरीटापस्चीसर्थ.

<sup>(5)</sup> A and B read wear, which is grammatically incorrect.

#### महादेव उवाच।

शृणु देवि प्रयक्षेन स्थानानि विविधानि च।
स्वर्णस्थोदयो धातोः सर्व्वव्यापकपर्व्वते। ११३॥
पार्थिव्यं हि च तत् सर्व्वे स्टामध्यात् प्रजायते।
तस्मात् स्थानस्य संचेपः श्रूयतां सादरं ग्रुमे ॥११४॥
हेमं च प्रथमं कल्पं मेक्मध्ये सदैव हि।
दुर्क्षमं मर्त्यं लोकेषु कष्टेनैव तु लभ्यते ॥११५॥
पुनर्षेमाद्रिणा तेन जायते सर्व्वदा ग्रुमे।
महायौतकतं तेन दुर्क्षमं स्थात् सदैव हि।॥११६॥
पथान्वस्थानदोद्धतं नस्यूदोपेषु जायते।
तस्य कष्टतरं मन्ये दुर्क्षमं तत् सदैव हि॥११०॥

A reads বনীর. B reads ঘদার. Both the readings are incorrect.

<sup>(2)</sup> पार्टिन्शनि च ते सर्वे, an incorrect variant in A and B.

<sup>(3)</sup> A and B read हाइराव which is incorrect.

<sup>(4)</sup> A reads महत्सीतहत, which is incorrect.

<sup>(5)</sup> B reads aga fe, which is incorrect.

पृथिष्यां धातुमध्येषु सर्वेषामधिकं सदा। सोद्याधिकतरं तत्र ज्ञातव्यं सर्वेदा ग्रुमे ॥ ११८ ॥ कष्टे नि:सारणं तेषां मौत्यादिधिकं जायते। तस्मात्तेनेव यत्नेन साधनं क्रियते नरे: ॥ ११८ ॥ यसाध्यसाधनं तस्य जातं सर्व्ययो ग्रुमे। तस्मानुः बहुमूत्वेन सर्व्यधातूपरिस्थितिः ॥ १२० ॥ पुन: स्थानं कृतं तेन सद्भायां च सदैव हि। छद्धितं तेन यत्नेन मर्त्तादुंभौतं मया ग्रुमे ॥ १२१ ॥

पार्वेखवाच 🗈

महारुद्र ग्रङ्गर श्रोमन्<sup>३</sup> लोकनाथ जगत्पति । कयं ते मानुषे भीतिः <sup>6</sup> कष्यतां परमेखर ॥ १२२ ॥

A has ক্ষর লব;
 B has ক্ষর লব;
 Both are incorrect.

<sup>(2)</sup> A and B read away, which is incorrect.

<sup>(3)</sup> चंबेधातीपरिस्थिति, an incorrect variant in A and B.

<sup>(4)</sup> A and B read erroneously 理理证.

<sup>(5)</sup> शीमान, a reading in A and B, is not correct.

<sup>(6)</sup> मानुषाद्योति: is the correct form.

महादेव उवाच । सुवर्णस्थैषा महती' भीतिर्मानुषसम्भवा । उद्यो नीचपदं सम्यक् जायते बहुले रति: ॥ १२३ ॥ मया मानुषभीतेन' उद्घितं सादरेण च । दुर्मभं च विशेषेण प्राक् कलियुगे ददम्<sup>3</sup> ॥ १२४ ॥

पाव्वंत्यवाच ।

मदीये मानसे नाथ जातोऽसी संगयो महान्। भवतां मानुषी भीतिः कथं तु जगदीखर'॥१२५॥

महादेव खवाच।

कारणं वर्त्तते देवि चव्याख्येयं सदैव हि। कथनीयं त्वयि भद्रे यतस्वं सस वक्कसा ॥ १२ ६ ॥

A and B read सुवर्णकोषा महतान्, which is not correct.

<sup>(2)</sup> मा च मानुवीभीतेन, an incorrect variant in A and B.

<sup>(3)</sup> A and B read TR. This foot is incomplete.

<sup>(4)</sup> A reads কথ বৈ লনহীয়াই. B reads কথ বৈ লনহীয়াই: Both are incorrect.

<sup>(5)</sup> and is an incorrect variant in A and B.

बुहिचतुरताष्ट्रहिर्जायते च कली युगे। मानुषे च भवतीष्ट्र' मम चोभानुवर्त्तिनी। १२०॥ तस्मात्तेर्वेष्टुलें दृख्ये साध्यते गन्धकी क्रिया। स्रथवा पारदी चेव मम चोभानुवर्त्तिनी॥ १२८॥

पार्वेत्युवाच ।
युता सा गन्धकी विद्या सर्व्वसीभाग्यदायिनी ।
सङ्गभचकता सा च न सिष्यति गरीयसी ॥ १२८ ॥
भवता पूर्व्वसुत्रं हि सङ्गभच्चवयोगतः ।
न सिष्यति च ते विद्या सदा गन्धकपारदी ॥ १३० ॥
तस्मानु कष्यतां देव मनो स्वानिविवर्जितम् ।
सुवर्णसाधिनीं विद्यां तस्मादुवदतु मे विभो ॥१३१॥

<sup>(1)</sup> A and B read with which is not correct.

<sup>(2)</sup> A and B read awie, which is incorrect.

<sup>(3)</sup> A and B read ? v.

<sup>(4)</sup> A reads Ha.

<sup>(5)</sup> A and B read सुवर्षमाधिनी विद्या-

#### महादेव उवाच।

मानसं मदीयं देवि जातं सम्यक् सुनिर्मालम्।
तथापि मानुषे भौतिर्विद्या' गन्धकपारदी ॥१३२॥
सङ्गभक्षणजं कष्टम् उमे मेलापनं महत्।
सष्ठ मन्वकते वङ्गी ज्वलते तत्क्यात् ततः॥१३३॥
मन्ववत् साध्येद्विद्यां साध्येद्यव्रतः क्रमात्।
तस्त्रात्तेनेव महता गोष्या सिहिकरी क्रिया॥१३४॥

पार्व्वत्युवाच ।

पुरा प्रोत्तां त्वया नाथ पटले पञ्चदयके । कैलासात् परमं सौख्यं भजते मन्त्रविज्ञनः ॥१३५॥ किया गन्धकिनौ मध्ये चथवा पारदी ग्रम । केलासादिषकं सौख्यं मुख्यते विधिवन्नराः ॥१३६॥

<sup>(1)</sup> A and B read fau, which is senseless.

<sup>(2)</sup> A and B have wig, which is incorrect.

<sup>(3)</sup> বতলী ঘঁৰাখিক, a variant in A and B, which is incomplete.

<sup>(4)</sup> A and B read নাথ কিবা.

<sup>(5)</sup> A and B read at, which is incorrect.

#### महादेव खवाच।

निर्मानं मानमं जातं तव वाकाविमोहितम्।
कययामास ते भद्रे गुणलचणसंयुतम्। १२०॥
स्वर्णौत्पत्तिस्वनं नित्वं सब्वैचापि विधीयते।
उत्पादनगतिस्तस्य स्थाने स्थाने प्रयक् प्रयक्॥ १३८॥
य्यतां वरदे देवि स्थानं चैव यथोदितम्।
तस्य वातोत्यजा रेणुर्धमने स्वर्णं जायते॥ १३८॥
पावकाद्रेभुवावाष्ट्रः सप्तरस्राकरे तथा।
समुद्रस्य तटे दिश्चे स्थानं स्थात् स्वर्णंकस्य च॥१४०॥
सन्द्रस्य तटे दिश्चे स्थानं स्थात् स्वर्णंकस्य च॥१४०॥
सन्द्रस्य तटे दिश्चे स्थानं स्थात् स्वर्णंकस्य च॥१४०॥
सन्द्रस्य तिविधेः स्थानेः सामातोत्पत्तिर्जायते॥१४१॥

<sup>(1)</sup> A and B read \*ga; which is not accurate.

<sup>(2)</sup> Both A and B read सर्चीत्पचि: खलं, which is not correct.

<sup>(3)</sup> A and B add wafter we.

<sup>(4)</sup> A reads पावकाद्रस्य ग्रभावाह. B reads पावकद्रस्य भुवावाह:.

तम तचीत्पत्तिस्तेषां यत्र यत्र हिमद्रवः।
प्रसरित भृवि संघाः संग्रयो नास्ति ते सदा ॥१४२॥
तास्त्रीत्पत्तिस महता सुखेनैव प्रजायते।
तिषां स्थानानि वस्त्रेऽहं यायातस्थेन च मृणु ॥१४३॥
निपाले कामरूपे च वङ्गले मदनेखरे ।
गङ्गाहारे मलादी च स्नेक्हदेशे तथेव च ॥ १४४॥
पावकादी जीर्णदुर्गे कमदेशे फिरङ्गके।
एतान्युदितस्थानानि सर्व्वपर्वतके सदा ॥ १४५॥
जासत्वं यत्तु दिस्यं हि स्थानानि तस्य च मृणु।
कुम्भाद्रावय काम्बोजे कमदेशे बस्त्वति ॥ १४६॥

<sup>(1)</sup> 福育 is the variant in A. 南南 is the variant in B.

<sup>(2)</sup> स्तानान् प्रवच्ये हं is the incorrect variant in A and B.

<sup>(3)</sup> A and B read ते प्रयू.

<sup>(4)</sup> नेपालं कामक्यं च, a reading in A and B.

<sup>(5)</sup> वक्वालं मदनेश्वरं, a variant in A and B.

<sup>(6)</sup> प्तानि चदितस्थानात, an incorrect variant in A.

<sup>(7)</sup> A and B read स्प्यंतरी, which is incorrect.

<sup>(8)</sup> A and B read वृत्ते.

<sup>(9)</sup> A and B read कु भादेय, which is incorrect.

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एतान्युभयो: स्थानानि रजःस्थानं च उच्यते। जासत्वं वङ्गले नागं नेपाले च सदैव हि ॥ १४०॥ केदारे कर्माकाण्डे च त्रास्वके त्रिपुरे तथा। एतत्स्थानानि दिव्यानि गोप्यान्यन्यानि तानि ह ॥ १४८॥

लोहाद्री' लोहकत्वर्धा गयाद्री गौतमाद्रिवे'। विन्धामध्ये हि सर्व्यव नलाद्री निष्कलीऽपि वा

11 586 11

- (2) A and B read townsien.
- (3) A and B read स्त्रानकान् दिस्यान्.
- (4) খলা নীআ নিবীবি ▼, a variant in A and B, which is senseless.
  - (5) A and B read लीकाडे, which is incorrect.
  - (6) Do. Do. गवाडे, Do.
  - (7) Do. Do. বীরনারিখ, Do.
  - (8) Do. Do. ৰাজনামী, Do.
  - (9) Do. Do. net2, Do.

 <sup>(1)</sup> एति ভদথী: ছ্যালান্, a reading in A. एति ভল্মী: ছ্যাশান্, a reading in B.

त्रास्वते विमले वैव लीडाकगालिवाइने। समुद्रस्य तटे रम्ये घाटो चन्ते च मध्यगे॥१५०॥ लोइस्प्रैतानि स्थानानि इाटकैय सदैव हि। किञ्चित् गोप्यानि दिव्यानि संस्कारै: रहितानि च

11 8 7 8 11

युक्ते तु संस्कृते तेषु स्वर्णी सिद्धिः प्रजायते। अयुक्ते नैव सभ्या तु<sup>६</sup> युक्ते प्राप्तिः सदैव हि ॥ १५२ ॥ पारदे गन्धके घात्वोः योग श्रीषधक्तत्<sup>7</sup> सदा। मानसे निर्माले चैव सभ्यते<sup>8</sup> हाटकी क्रिया॥ १५३ ॥

<sup>(1)</sup> A reads fund.

<sup>(2)</sup> चीइस्तेतानि च स्थानात, a variant in A and B, which is incorrect.

<sup>(3)</sup> A reads wiz v.

<sup>(4)</sup> 希何有 is the reading in A and B, which is incorrect.

<sup>(5)</sup> A reads €. B reads ₹.

<sup>(6)</sup> A and B read অথক, which is not correct.

<sup>(7)</sup> Do. Do. बोम्बीवच्छत्, Do.

<sup>(8)</sup> Do. Do. and, Do.

षन्यया नैव सभ्या तु विना मन्त्रेण सिध्यति। तसादेवं प्रयत्नेन निर्मासं मानसं ग्रभम् ॥ १५४॥ षश्भं समसं चैव मानसं सर्व्वदा भवेत्। तसात्तु चतुराहारं सर्व्वदा ग्रभमानसः ॥ १५५॥ जायते च क्रिया सिद्धा हाटको भवति सर्व्वदा। मन्त्रसिद्धिः प्रजायेत सर्व्वकर्माणि साध्येत् ॥१५६॥ षनेनैव प्रकारेण उत्तमा हाटको क्रिया। सर्व्वकार्यकरी नृणां चतुर्वभैक्षसप्रदा॥१५०॥

महादेव उवाच। प्रोत्तसंपुटके चैव स्यूलकाचीयकेन च। उत्पाङ्गारकते चन्नी सुमुरं कागरेकजम् ॥ ८॥

<sup>(1)</sup> A and B read was, which is not correct.

<sup>(2)</sup> A and B read तकाई≠, which is not correct.

<sup>(3)</sup> A reads चतुराहार, which is unintelligible.

<sup>(4)</sup> A reads क्रोरिंग. B reads चतेरिंग.

खर्पराख्ये पुटे चैव घारखात्म सकत च।
सार्वे विनास्ति(?)गित च ज्वलिते घर्षमर्देगे ॥१०॥
एवानुक्रमतो योगे पुटमेकं च जायते।
चतुरंग्रेन जामले सुवर्णाद्दापयेत् सुधीः॥११॥
प्रति संपुटपुटे चैव उद्घयेत् कुण्डखर्परे।
स्वाङ्गगोतं समुद्द्र्य लेपमुत्तारयेत्ततः ॥१२॥
पुनर्लेपः प्रदातव्यः पुनः चारान् प्रदापयेत्।
पुनरेव घोटनं देयं सादरं पुनरेव हि॥१३॥
घननेव प्रकारण तुर्व्यागसंपुटेन हि।
सुवर्णसंयुतं तच्च गालयेत् चारसंयुतम्॥१४॥
ज्वलिते तोलयत्येव तिलावे संपुटं प्रति।
नम्बोभृतं च रच्चेयं संस्कारैः ग्रध्य साम्यतम्॥१५॥

<sup>(1)</sup> A and B read अवितरहर्दना.

<sup>(2)</sup> আৰ্থনিব is the reading in A and B, which is not accurate.

<sup>(3)</sup> A and B read लेपमुनारणं तत:, which is incorrect.

<sup>(4)</sup> A and B read पुनर्शेष प्रदात्रका, which is not correct.

<sup>(5)</sup> A and B read # which is incorrect.

एतत्क्रमक्रमेणैव सुवर्णं मनुसंचय।
तद्गुणे योणिमापीते महत्ततः प्रजायते॥१६॥
घारकं पौतसंयुक्तं जायते हाटकं महत्।
हाटकं मत्तकं चैव न च हौनेन योजयेत्॥१०॥
कलागुणगते हिंद्रजीयते उत्तमे नरें।
घनेनैव प्रकारेण मात्राहिगुणं दापयेत्॥१८॥
कांद्रावयं मिते हिंद्र्रांपिता हिंद्रिष्यते।
निर्देषं जायते दिखं द्रव्यसंपत्तिदायकम्॥१८॥

पार्व्वत्युवाच । प्रधिकेन क्षते तत्र श्रोणपाने सुग्रोभने । जायते **कौ**दृशं देव संयोगे प्रधिके सति ॥ २०॥

<sup>(1)</sup> A and B read graff, which is not correct.

<sup>(2)</sup> A and B read इंटिंग मस्त भेद.

<sup>(3)</sup> उनमी नरः, a variant in A and B.

<sup>(4)</sup> A and B have क लावक.

<sup>(5)</sup> A and B haye ≥ M, which is incorrect.

#### महादेव खवाच।

योणपाने च संयोगे भङ्गदः घस्ति निषयः।
हिगुण योणपानेन कलंकं जायतंऽग्रभम् ॥ २१ ॥
विध्यंगं सुधनार्थे विद्यांभे दिक्पलोपमम्।
घतिरक्षकतं तच जायते सगुणं महत्॥ २२ ॥
गालयेद्यवपूर्वेण कायेद्रससमांभके।
समाग्रे गन्धकं देयं ग्रहं पीतक रागकम् ॥ २३ ॥
चयतुर्थांग्रकं तालं दापयेद्रसमोदितम्।
तदहं सादरं देयं मह्येत् कन्यकारसे ॥ २४ ॥
यामवितयमामहंगे कायाग्रकमण्ड्ने रसे।
घतिग्रस्थेतरे खन्ने घयवा सोहसंभवे॥ २५ ॥

<sup>(1)</sup> A and B read wast wie, which is incorrect.

<sup>(2)</sup> Do. शियुषे.

<sup>(3)</sup> Do. us, which appears to be incorrect.

 <sup>(4)</sup> Do. पौषत, which is senseless
 বালববদানত, an incomplete variant in 'A and
 (5)

मईयेद्यसपूर्वेण कायागीवतं कारयेत्।
काचक्ष्ये प्रदातव्यं विक्रिगीलुक्यन्त्रगः ॥ २६ ॥
नखसंख्यामिते यामे पाचयेद्रसं ग्रोभने।
स्वाङ्ग्योते तु संजाते पुनः खन्ने निधापयेत्॥ २० ॥
रसेनानेन सामद्रेग कायागोपितं कारयेत्।
उक्तयामे रसे दत्ते पुनः ग्रोयं प्रदापयेत्॥ २८ ॥
उक्ताम्नौ दापयत्येव पुनः संस्कारमाचरेत्।
संस्कारे विविधे जाते सम्मिपूर्वे क्रमोदिते॥ २८ ॥
नायते रसराजोऽसौ सर्वेसामर्थेदायकः।
संचयेत्तर्ण्युलार्डस्तु स्रतिविक्रमवेगवान्॥ ३० ॥
नायते प्रवला बुद्धः विदिने सेवते यदिः।
सार्वेष्ठदिक्रमनेव दिने मास्रकलं सदा॥ ३१ ॥

<sup>(1)</sup> मदातच्या, a reading in A and B.

<sup>(2)</sup> बन्या, a reading in A and B.

<sup>(3)</sup> tel is the variant in A and B.

<sup>(4)</sup> nim is the incorrect reading in A and B.

<sup>(5)</sup> A and B read स्वीतापि, which is grammatically incorrect.

जायते नाव्र सन्देष्ठः सिडिगैन्धकसन्धवा। धनेनैव प्रकारेण रससिष्ठिः प्रजायते॥ ३२॥

पार्व्वत्युवाच ।

म्बेतता कर्माणा केन<sup>1</sup> जायते रजतेषु च। क्रमेण राजती सिंडि: पद्याडाटकसम्भवा॥ ३८॥ सन्डाटेव उवाच।

षवानन्तरता विद्या धातुसंस्कारकारियो । जासत्वे कठिने जाते ग्रुद्धे कोमलकारियो ॥ ३८ ॥ तथाच पीतग्रस्थेषु जायते ग्रुद्धनम्त्रता । त्रुण यत्ने क्रिया दिव्याः ग्रुद्धजासत्वसम्भवाः ॥ ४० ॥ पिष्टं चयखुरीत्यं च हिगुणं धातुतः सदा । षर्धन्तु दापयेत् स्तावे ग्रुद्धं निस्ते च "रच्चयेत् ॥४१॥

<sup>(1)</sup> केन कर्भेष, an incorrect variant in A and B.

<sup>(2)</sup> 可模型 is the reading in A and B, which is not correct.

<sup>(3)</sup> A and B read face.

निर्मालं धातुजं द्रावं सावचूर्णंन ढालयेत्।
यदं च स्थितं निस्तं तत्कालं दापयेत् सुधीः ॥४२॥
उपि संपुटं देयं ससुद्रकुक्टे पुटे ।
स्वाक्त्रशीतं ससुदृत्व जायते निर्मालं महत् ॥ ४३॥
जासत्वे सीमलं देयम् उक्तभागेन साम्प्रतम्।
चूर्णान्तरगतं कत्वा उज्जूलं जायते महत् ॥ ४४॥
तदेव जासत्वं चैव दिव्यम् उज्जूलगं सदा।
कृष्यादं मेलयत्येव जायते शहता शभा॥ ४५॥
धनेनैव प्रकारण धनं किश्विच जायते।
धने चैव तु संजाते कारयेटूईजाः क्रियाः ॥ ४६॥

भतीव योभना विद्या रसगन्धकजा सदा। भतिसीभाग्यदा सा<sup>4</sup> च साधके सुखदायिका I4टा

समुद्रं कुकुट पटे, a variant in A and B, which seems to be incorrect.

<sup>(2)</sup> ভলমীগৰ, a variant in A and B.

<sup>(3)</sup> A and B read # Q4, which is not correct.

<sup>(4)</sup> Do. a Do.

एताह्यं च जासत्वं योधितं गन्धकेन च।
धानधौतेन ताम्बं च पुष्तितं सुभगं सदा ॥ ६८ ॥
पुष्तितं जायते दिव्यं शुष्तिपौतं शुभोदितम् ।
निर्मानं जायते तच्च होनहाटकसित्रभम् ॥ ६८ ॥
लघुता जायते तस्य किश्विनार्थ्या गुरुता सदा ।
जायते गुरुता दिव्या पुष्तिते हाटकेन च ॥ ७० ॥

२८ ग-पटलादुवृताः योकाः । पार्व्वत्युवाच । पूर्व्वमुक्तं त्वया नाथ धने सिहिस्तु जायते । सम्बद्धवक्तते धातौ वदं किंतत्र मुद्धते ॥ ४३ ॥ महादेव स्वाच । क्रिया घम्नेः ग्रभा तेषां द्रव्यसिहिविधायिनौ । मृश् यत्नेन तां भद्रे क्रियां रंगीति नागजाम ॥४४॥

<sup>(1)</sup> A and B read g'ford.

<sup>(2)</sup> A and B read wift, which is incorrect.

<sup>(3)</sup> A reads av. B reads av:

श्रानयेत् पारदं दिव्यम् श्रधकर्ष्वपातितम् ।
चानयेद्यवपूर्वेण खन्ने पिष्टं तु कारयेत् ॥ ४५ ॥
तैलेनानेन श्रामद्देर भावना चणमावतः ।
निन्ने डमक्ते यन्त्रे श्रम्निं द्यादृत्विचचणः ॥ ४६ ॥
उत्ययेद्यामयुग्मे न खाङ्ग्योतं समुद्दित् ।
पुनः समाननागेन पूर्व्ववत् चानयेत् सुधोः ॥४०॥
पुनरेव इठादग्नी उक्तयामेन सिद्धाति ।
रसे दिवारके चैव होनहिमोत्तमोत्तमः ॥ ४८ ॥
तौलिके रिक्तकायुग्मं दापिते वर्णपञ्चकम् ॥ ४८ ॥
प्रनेव प्रकारण जायन्ते घोड्ण कलाः ॥ ४८ ॥
प्रव्यव्वद्विकरं तच्च जायते नात्र मंग्रयः ।
पुनरेव क्रिया रम्या पारदे नागचारिणो ॥ ५० ॥
दिगुणे चारिते तवः जायते चन्द्रिका ग्रमा ।
श्राभासेन ग्रिखियोवा जायते नात्र मंग्रयः ॥ ५१ ॥

<sup>(1)</sup> डीनडेमीशम:, an incomplete variant in A.

<sup>(2)</sup> 草啄布: is the reading in A and B, which is incorrect.

<sup>(3)</sup> A w is the incorrect reading in A and B.

पुद्धिते हीनहेमेन जायते क्रयविक्रयः।
श्रमेनेव प्रकारेण जायते धनसंपदः॥ ५२॥
श्रतकः क्षेत्रिया या चं विद्या नागस्य सम्भवा।
ससे तु नागजे चैव विधिनानेन वर्त्तते॥ ५३॥
तायते सकला विद्या नागतेलस्य संभवा।
सर्व्या सां शोभना विद्या तोव्रदारिद्रानाशिनी॥५४॥
श्रयातः संप्रवस्थामि व्रपूणां विधिमुत्तमम् ।
येन विद्यानमावेण जायते रजतं महत्॥ ५५॥
श्रमेका राजती सिविः जायते परमोत्तमा।
जायते धनसिद्धियं जायते नाव संशयः॥ ५६॥

- (1) A and B read 智 which is incorrect.
- (2) A and B have ath, which is incomplete.
- (3) A and B have at, which is notcorrect.
- (4) A and B have বিশিক্ষণা, which is grammatically incorrect.
- (5) A and B have zaτη instead of ¬σ, which is a tautology.

पार्व्वत्यवाच । वद वैभवदातारं वङ्गं विज्ञानदायकम् । ज्ञात्वा सिडिमवाप्रोति गुणज्ञै: सौख्यकं च यम् ॥५०॥

महादेव उवाच । 0 भानयेच्होभनं वङ्गं विस्थाचलसमुद्रवम् । गानयेद्यत्नपूर्वेण ढालेत् समाग्डने रसे॥ ५८॥ ति:सप्तकस्तते तव" जायते निर्मालं ग्रभम् । तदुत्थान् कारयेत् पत्रान् ग्राचिविद्वान् यथोदितान्

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रचयेद्यद्वपूर्व्वेष चानयेद्वर्किकं वयः । भावयेत् ग्रांताकाचूर्णम् उज्जुलं विक्रियोधितम् ॥६०॥

<sup>(1)</sup> दाना च, a variant in A and B.

<sup>(2)</sup> दायक:, a variant in A and B.

<sup>(3)</sup> a ■ is the incorrect variant in A and B.

<sup>(4)</sup> A and B read तदील्यान, which is incorrect. The word पत्र is used here in the masculine gender.

<sup>(5)</sup> B reads afgai.

मईयेद्यक्षपूर्वेण यावक्षेप: सुलक्षतं । यवादं लेपयत्येव पत्नान् तु यत्नपूर्वेकम् ॥ ६१ ॥ कायाग्रुष्के च संजाते दापयेक्कृतिसंपुटे । चृड़ाधो लेपयत्येव सन्धो यत्नेन सुद्रयेत् ॥ ६२ ॥ मेलितौ माषगोधुमा पिष्टलेपं प्रदापयेत् । कायाग्रुष्के च संजाते सुक्ष्यं लेपं दापयेत् ॥ ६३ ॥ सुग्रुष्के च गजी पाच्यं खाङ्गगीतं समुद्रत् । जायते उक्कबलं वङ्गं वातग्रुष्कं तु कारयेत् ॥ ६४ ॥ यः कस्वत् सूर्व्कितस्वव जीवयेक्जीवनक्रियाम् । स हि वङ्गाययेणैव उक्कबलः कठिनो भवेत् ॥ ६५ ॥

যাবর্থক ভাষ্ট, a variant, which seems to be incorrect.

<sup>(2)</sup> guer, a variant in A and B.

<sup>(3)</sup> सांगगीत, a variant in A and B.

 <sup>(4)</sup> ই কিবিন্ নুদ্ধিন বিশ্ব, an incorrect variant in A
 and B.

<sup>(5)</sup> सहैवंबाखरीक्षेव, a variant in A and B, which is unintelligible.

<sup>(6)</sup> A and B read ভক্তা করিছা, which is incorrect.

श्रितग्रहतरं तच जायते नाव संग्रयः।
सर्व्वकर्माकरं श्रेष्ठं नानाभागेन पुष्तितम्। ६६॥
भोगभागसमायुक्तं वङ्गं च गुणसंयुतम्।
लचणार्थे' धनार्थे च संयोगे साध्येत् सदा॥ ६०॥
जायते सभगं तच संसारे शोभनं भवेत्।
श्रिनेव प्रकारेण जायको धनसम्पदः। ६८॥
पार्व्वत्युवाच।
स्वी ग्रहतरे जाति का क्रिया वद से विभो।
सच्चणार्थे धनसंपत्तेः क्रिया या च प्रथक् प्रयक्॥ ६८॥

महादेव उवाच। सच्चणेन' च नारीणां भिन्ना भिन्नेन वर्त्तते। धनेका धनदा विद्या जायते सुभगा महत्॥ ७०॥ धतीव शोभना सा च गुणसामध्यदायिका। येन विज्ञानमाचेण साधके धनमुत्तमम्॥ ७१॥

<sup>(1)</sup> B reads wanti.

<sup>(2)</sup> খলাই is omitted in B.

<sup>(3)</sup> সাহন খন-ভব্ল, a variant in A and B.

<sup>(4)</sup> A and B read werde.

जायते नैव सन्देन्नो धनसामध्येकं महत्।

श्रतिसौभाग्यसम्पत्तिर्जायते नात्र संग्रयः ॥ ७२ ॥
श्रानयत् ग्रदं तं वङ्गं गालयत् टक्कणैः सह ।

पिख्याकसुरसे दिख्ये टालयेद्यत्वपूर्व्वकम् ॥ ७३ ॥
सप्तटालकते ग्रदे कठिनं रजतोपमम् ।
जायते नैव सन्देन्नः पुष्तिते रजते ग्रुभे ॥ ६४ ॥
रजतं जायते ग्रदं संभारं कारयत् सुधीः ।
श्रन्थेष्वेव विधिर्दिच्यो दिव्यरजतसंभवः ॥ ७५ ॥
श्रानयत् ग्रोधितं वङ्गं तददं पारदे क्रलेत् ।
निधायं ग्रोभने खत्ने तुर्योग्रे दापयत्ततः ॥ ७६ ॥
महंयत् कन्यकावीर्य्यं यामं थोड्ग यत्नतः ॥ ७६ ॥
सस्यद्या रसे दिख्ये तत्मसं महंयत् सुधीः ॥ ७० ॥
समानाच्छरसेनेव महंयद्यत्वपूर्वकम् ।
कायाश्रष्ट्ये च संजाते श्रोषान्ते वालके पचेत् ॥ ७८ ॥

<sup>(1)</sup> दिन्दादिन्य रजतसंभवा, a variant in A and B.

<sup>(2)</sup> A and B read frequ or frequent

<sup>(3)</sup> यवप्रकंक:, a variant in A and B.

<sup>(4)</sup> कावायक्तन, a variant in A and B.

<sup>(5)</sup> A reads alrata. B reads elasta.

श्रानिव प्रकारण क्रमादिन प्रदापयेत्।
प्रदाष्टकेऽष्टकेनेव विवारं हठं दापयेत्। ७८॥
जायते च रसं दिक्यं भच्यो च सुधाममम्।
नारीणां दापयेद्यवे संयोगे नागकेसरै: ॥ ८०॥
तदर्काः सुष्ठुं गोधूमाः सहैवं तोलकार्डम्।
श्रातसीस्थकरं तच्च रिक्तमावार्डे वर्दते॥ ८१॥
पुंसि श्रजगुणोपेते यथा च गंधकी गतिः।
नरार्थे भच्यो यातो जातिवयसमन्वितः॥ ८२॥
श्रानेव प्रकारण क्रमण वर्दयेद्रसम्।
जायते रसजा सिद्धिः नाच कार्या विचारणा॥ ८३॥
सुक्तत् सुधाकरं वद्वं गालयेद्यव्वपूर्व्वकम्।
तज्जलं शोषयत्येव श्रतांशे रसदापिते॥ ८४॥
रजतं जायते श्रदं कलाद्वाविंशतः स्फुटम्।
श्रम्यं वै मेलयत्येव विकाये श्रमदं महत्॥ ८५॥

<sup>(1)</sup> A reads मागकेसरे.

<sup>(2)</sup> B reads fag.

<sup>(3)</sup> A and B read # which is incorrect.

स्रनेनैव प्रकारेण जायते धनसंपदः।
साधयेत् सिविदा विद्या देहसामध्येदायिनी ॥८६॥
मेन्नयेदभोगभागेन महंनाहरदो विधिः।
पीते भावनया श्रम्ती। सार्वहर्षेन सिवयेत्॥ ८०॥
श्रवतास्त्रे प्रदातव्यं श्रतिश्रे हाटकोत्तमम्।
जायते नाव सन्देष्ठो यथा जास्त्रृनदोइवम्॥ ८८॥

पार्व्वत्युवाच ।

ताम्बं च तुत्यजं दिव्यं जायते केन विक्रियाम् । यद विश्वेखर शक्षो सिद्धं ताम्बविधानकीम्<sup>8</sup> ॥६४॥

महादेव खबाच।

शृष् ग्रह्मियां दिव्यां तृत्यतास्त्रस्य सम्भवाम्। येन विज्ञानमात्रेण साधयेद्रसकुम्पिकाम् ॥ ६५ ॥ साधयेत् पञ्चासृतं दिव्यं महासीस्व्यदायकम्। ज्ञात्वो कालीन लीयेत संसारसुखभाजने॥ ६६ ॥

<sup>(1)</sup> A and B read tut, which is incorrect.

<sup>(2)</sup> सिद्धा तास्त्रधानक', an incorrect variant in Δ and B.

यानयेत्यकं दिव्यं पीतगन्धकसम्भवम्।
दापयेच्छोभने खन्ने प्रकंचीरण भावयेत्॥६०॥
सहयेद्यत्वपूर्वेण याममात्रमखण्डितम्।
तेनैव धातुयोगेन सुवर्णे सुलभतां त्रजेत्॥६८॥
एताह्यो परा धातुर्वेत्तंते धातुमध्यमा।
सुलभा ग्रभदा प्रोक्ता मम साविध्यमा मदा॥६८॥
पाव्यत्युवाच।
ये गुणा नागजे तास्त्रे वद विखस्य वद्यम।
प्रयोजनवस्तु ग्रक्यं चतुरेणेव चोदितम्॥८५॥
महादेव उवाच।
प्रनेका गुणां नागेषु पूर्वंसुक्ता हिं पारदे।
किश्वित् ग्रेषतरा ये च ग्रुणु देवि प्रयत्नतः॥८६॥

A reads याननाव मसंदित:. B reads शाममावे मखिलत:.

<sup>(2)</sup> A and B read Havi:

<sup>(3)</sup> भनेकान् गुषान्, a variant in A and B.

<sup>(4)</sup> নুজাৰি পাংই, an incorrect variant in A and B. 10

नागस्य सम्भवं तास्तं मध्ये मेलापनं कतम्।
विभागे तु कते तत्रं जायते कुम्पिका ग्रभा ॥ ८० ॥
तम्भव्ये गासयेकागं विवारं यव्वपूर्व्वकम्।
जायते निर्मालं स्वर्णम् उदितं चैव कुम्पिके ॥ ८८ ॥
विभागे साम्प्रतं दस्वा असतं जायते ग्रभम्।
उन्नकार्थकरायते नान्यया वचनं मम ॥ ८८ ॥
तस्त्रात् साध्यते दिव्यं भूनागोद्ववजं ग्रभम्।
प्रनेका साध्येद्विद्या रससामध्येदायिका ॥ १०० ॥

Colophon in A

इति चौरूद्रयामले उमामहेम्बरसंवादे सुवर्णकरूपे सुवर्णप्रयंसा नामाध्याय:।

Colophon in B

दति यीद्यामनी उमामहिखरसंवादे धातुमंजर्था सवर्णप्रशंसा समाप्ता।

<sup>(1)</sup> A and B read ? which is incorrect.

#### Extracts from

## SUVARNATANTRA

## or SVARNATANTRA.

## सुवर्णतन्वात् वा खर्णतन्वात्

उड्डताः श्लोकाः।

A = MS. from Benares. \*

B = MS. from Ramnákáli's matha, Dacca. †

श्रोगणेशाय नमः।

यौराम उवाच। देवदेव महादेव ऋडिबुडिफलप्रद। पूर्व्वे संसूचिता ऋडो रसायनपरा परा॥१॥ यस्याः साधनमात्रेण स्वाराट्तुस्यो नरी भवेत्। तां सिडिंवद मे देव यदि त्वं भक्तवत्सस्तः॥२॥

The name of this MS. is स्वणंत्रवस.

<sup>†</sup> The name of this MS. is स्र्वतन्त्रम्.

पूर्वे तु कथितं देव रक्षतन्त्रं त्वया सम ।
गुटिकाः कथिताः पूर्वे सहस्रहितयं थिव ॥ ३ ॥
पारदाः कथिताः पूर्वे षट्गतं स्तिरूपकाः ।
धातृनामष्ट कन्पास्तु पूर्वेमेव प्रकाशिताः ॥ ४ ॥
धातृयोगाख्यकस्पस्तु पूर्वेमेव प्रकाशितः ।
रक्षानां करणे तन्त्रं पूर्वेमेव प्रकाशितम् ॥ ५ ॥
किन्तु खर्णाख्यतन्त्रं तु न सद्यं कथितं प्रभो ।
कथ्यपेन सहिशानाभ्यदितोऽस्मि सहिश्वर ॥ ६ ॥
भूमिदानं सया दक्तम् ऋषये कथ्यपाय वै ।
कथ्यपेन सिय प्रोक्तं भूमिभागं त्यज प्रभो ॥ ७ ॥
स्थानायं तु सहिशान रक्ताब्धः प्राथितो सया ।
वृाणसात्रं खलं तेन दक्तं सम सहिश्वर ॥ ६ ॥
स्थानं प्राप्तं सहिशान भव्यां सम नास्ति वै ।
सव्यां दिहि मे देव यदि पृक्षोऽस्मि शक्कर ॥ ८ ॥

#### द्रेग्बर उवाच।

शृक्षुराम प्रविद्यामि रहस्यातिरहस्यकम् । स्वर्णतन्त्राभिधं तन्त्रं कल्परूपेण कव्यते ॥ १० ॥ तवादां स्वर्णतम्बस्य कलां मृणु सुपृत्तुक । तैलकन्दाभिधः कन्दः सिडकन्दः प्रकोत्तितः । ११॥ कन्दः कप्रसवसम्य पत्राणि कञ्चवश्चित्रयो। तथैव तुमहत्पत्नं तैलं स्त्रवित सर्व्यदा । १२ । जनमध्ये सदा पुत्र त्वाद्रै एव प्रतिष्ठते । विषकन्देति विख्यातो विषाच कायनाग्रन: ॥ १३ ॥ तैलस्रायो महाकन्दः परितस्तैलवज्जलम् । दग्रहस्तमिते देशे सरते तेलवज्ञनम् । १४ । महाविषधरः पुत्र तदधो वसति धुवम्। कन्दाधः कन्द्रच्छायायां नान्यत्र गच्छति प्रिय ।१५। तत्वरीचाविघानायै जन्दे सूचीं प्रवेशयेत् । स्वीदावः चपात् पुत्र तत्कन्दन्तु समाइरेत् ॥ १६ ॥ तत्कम्दं तु समादाय गुडस्तं खलेचिधा । मूषायां निचिपेत् तन्तु तत्तेलं तत्र निचिपेत् ॥ १७ ॥ दौप्तान्निं तु महाराम वंशाङ्करेण दापयेत्। तत्त्रपास्त्रतिमायाति लचवेधो भवेत् सुत ॥ १८ ॥ ततः प्रभचयेद्रामः जुबिद्राचारको भुवम्। तालं गुडं समानीय तत्तेलेन खलेत सुत । १८ ।

सप्तथा प्रत्यश्चं राम त्वेवं विश्वहिनं भ्रवम् ।

श्वरतालो स्तिमिति निर्भूमो जायते भ्रवम् ॥ २० ॥

श्वर्मो पुत्र ततो दद्यात्रिर्भूमो जायते स्त ।

तत्तालं चाष्टधातौ तु दद्याद्द्रावे स्तते सित ॥ २१ ॥

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तत्त्वणात्तास्त्रवेधः स्वात् दिव्यं भवित काञ्चनम् ।

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तास्त्रे लोहे तथा रौत्यां तारे खर्परस्तके ।

तत्त्वणात् विधमायाति दिव्यं भवित काञ्चनम् ६२४॥

तत्वणात् विधमायाति दिव्यं भवित काञ्चनम् ६२४॥

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<sup>\*</sup> The above 24 Slokas are not found in MS. A.

पश्चानां तु परीचा वे कथ्यते शृणु साम्मतम् ।
लीइस्चीं समादाय लीइदावे विनिचिपेत् । ३ ।
तत्चणाइवतां याति सा स्ची नात्र संग्रयः ।
तास्त्रवि तथा स्चीं सिक्षमेदीं विनिचिपेत् ॥ ४ ॥
स्चीदावो याममात्राद्भवत्येव न संग्रयः ।
गंखद्रावे गंखस्ची चतुर्यामेन संद्रवेत् ॥ ५ ॥
इन्तालोऽघी यदा गच्छेत् दन्तायास्ता भवन्ति हि ।
दन्तद्रावोऽप्यधो गच्छेद्दन्तद्रावो भविष्यति ॥ ६ ।
एवं परीचां कत्वादी प्रयोगानारभेद्ष्रवम् ।
वजुम्मूषां ततः कत्वा ग्रह्मूतं विनिचिपेत् ॥ ० ॥
लीइस्चीद्रावरसं तच यत्नेन निचिपेत् ।
तत्नाम्निं दापयेद्यत्नात् पुनस्तत्ने रसं चिपेत् ॥ ८ ॥

<sup>(1)</sup> The above 7 hemistichs are not found in A.

<sup>(2)</sup> A reads ইবাছাখা. B reads হ্ৰাছাখা. Both the readings seem to be incorrect; since B has ছ্ৰাছত্ত অবুইছ: in the 2nd Sloka.

<sup>(3)</sup> B reads gager, which is not correct.

स स्तो स्ततामिति नाव कार्या विचारणा ।

पष्टधातुषु तं स्तं दत्ता काञ्चनतां व्रजेत् । ८ ।

तं स्तं भचयेद्यो हि सोऽमरत्वमवाप्रयात् ।

तस्य सूत्रपुरीषेषु ग्रुलं भवति काञ्चनम् ॥ १० ।

तास्त्रदावप्रयोगं वे युण् यक्षेन साम्प्रतम् ।

तद्रसं तु समादाय ग्रहतास्त्रे विनिच्चित् ॥ ११ ॥

तत्तास्त्रं स्वर्णतां याति भैरवस्य प्रसादतः ॥ १२ ॥

Colophon in A—इति त्रोसुवर्णतंत्रे हरपार्वतीसंवादे दुस्पर्भाकस्यः हितीयः।

Colophon in B—इति खर्णतन्त्रे जोहद्रावादिपश्च-फलकस्पो हितीय:।

<sup>(1)</sup> B has सा मुची चतिमात्रीति.

<sup>(2)</sup> A reads स गच्छेदमरलता, which is incorrect.

<sup>(3)</sup> B reads gwg.

<sup>(4)</sup> प्रवतासे पु निविधेत्. a variant in B.

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